Notes for

Data Analysis Workshop

T. Ramayah
School of Management
Universiti Sains Malaysia

OBJECTIVES

The primary objective of this laboratory session is to familiarize participants with the SPSS software when analyzing data for research purposes. At the end of the session the participants are expected to be able to:

- Enter and define data in a proper manner,
- Navigate the data window of SPSS,
- Choose data for selective processing,
- Use the Syntax Window for purposes of definition and manipulation of raw data
- Provide appropriate commands for the techniques identified – Descriptives, Test of Differences, and Relationships,
- Navigate the output window,
- Generate graphical outputs,
- Edit the output in the output window, and
- Transfer outputs from SPSS to other presentation format – Word, Powerpoint.

1. PEDAGOGY

To achieve the above objectives, this one-day session will focus on hands-on training in the use of SPSS. It will assume some basic knowledge of statistics.

2. CONTENT

The laboratory sessions will cover the following:

- Introduction to SPSS – the three windows and their purposes,
- Creating the Database
    - Data entry – Data Window,
    - Data Definition,
    - Data Checking,
    - Data Manipulation
- Analysing the Data
    - Checking the Data Structures,
    - Descriptive Statistics
    - Test of Differences
    - Relationships
- Reporting your findings
    - Transfers of Output to other presentation format – Copy and Copy Objects for Word and Powerpoints
    - Graphical Summaries Generations

1. Explain the Levels of Measurement

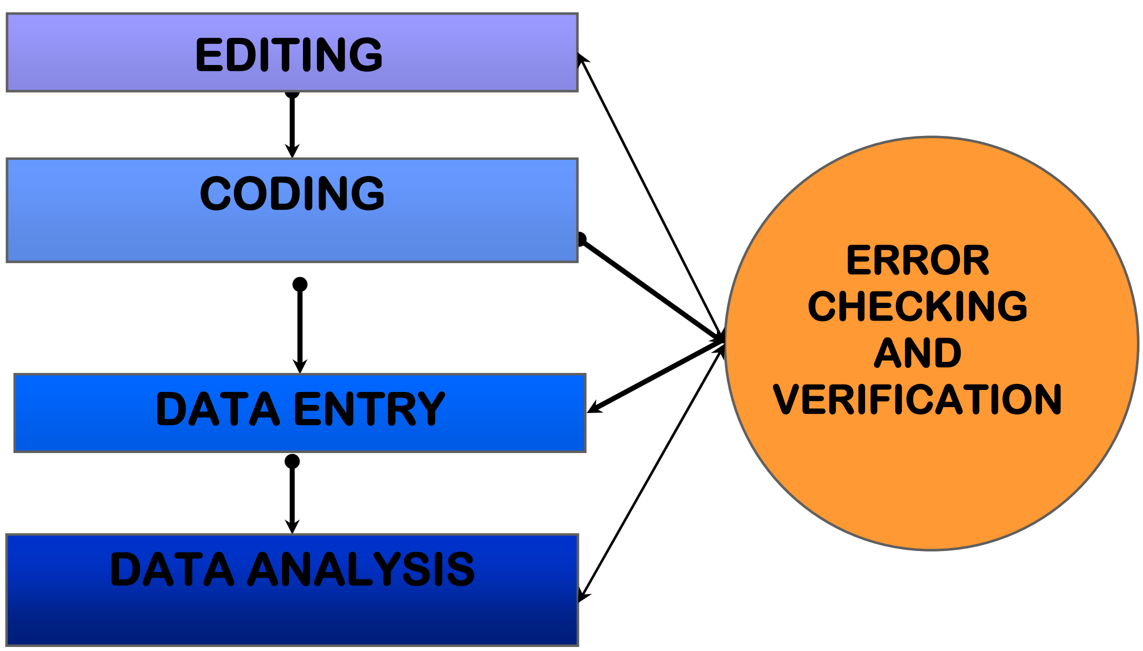
- Nomina
- Ordinal
- Interval
- Ratio

2. Explain the various types of variables

- Independent
- Dependent
- Moderator
- Mediator
- Control

3. Stages in Data Analysis

- Preparation of Data
  - Editing, Handling Blank responses, Coding, Categorization and Data Entry
  - These activities ensure accuracy of the data and its conversion from raw form to reduced data
- Exploring, Displaying and Examining data
  - Breaking down, inspecting and rearranging data to start the search for meaningful descriptions, patterns and relationship.



a. Editing

- The Process of Checking and Adjusting the Data for
  - Omissions
  - Legibility
  - Consistency
- Types of Editing
  - Field editing
  - Central Editing

b. Coding

- Involves assigning numbers or other symbols to answers so the responses can be grouped into a limited number of classes or categories.
- Example:
    - "M" for Male and "F" for Female
    - "1" for Male and "2" for Female
    - Numeric vs Alphanumeric
- Numeric versus Alphanumeric
- Open ended questions
- Check accuracy by using 10% of responses

Four rules guide the establishment of category sets:

- Appropriateness
- Exhaustiveness
- Mutual Exclusivity
- Single Dimension

- **Let's say your population is students at institutions of higher learning**
- **What is you age group?**
  15 – 25 years
  26 – 35 years
  36 – 45 years
  above 45 years

- **What is your race?**
  Malay
  Chinese
  Indians
  Others

- **What is your occupation type?**

Professional	Crafts
Managerial	Operatives
Sales	Unemployed
Clerical	Housewife
Others	

c. **Entering data**

- Using the SPSS Data Editor
- Other software

Enter the first 5 rows of data

4. Creating the database

- Variable names
- Variable labels
- Value Labels
- Missing values
    - Strategies for handling missing values
        - If > 25% missing, throw out the questionnaire
    - Other ways of handling
        - Ignore (system missing)
        - Use the midpoint of the scale
        - Mean of those responding
        - Mean of the respondent
        - Random number

- Transforming existing data to form new variables or items
        - Recode

Age	1	27 years and below
	2.	28 – 35 years
	3.	Above 35 years
Total Work	1.	1 – 4 years
	2.	5 – 8 years
	3.	9 – 12 years
	4.	More than 12 years
Organization	1.	1 – 2 years
	2.	3 – 5 years
	3.	More than 5 years

        - Compute

    - Reason for Transformation
        - to improve interpretation and compatibility with other data sets
        - to enhance symmetry and stabilize spread
        - improve linear relationship between the variables (Standardized score)

Checking the Data

1. Take a sample say 10%
2. Run a descriptive analysis

    a. Frequencies for the nominal and ordinal data
    b. Descriptive for the interval and ratio data

3. Actions to Insert/Delete
    a. Variable
    b. Case

4. Merging and Splitting Files

5. Selecting Cases

5. Goodness of Measures

1. Validity

- Factorial Validity
    - To confirm the theorized dimensions
- Criterion-related Validity
    - Power of the measure to discriminate
    - Concurrent and Predictive
- Convergent Validity
    - Two different sources has high correlation on the same measure
- Discriminant Validity
    - Two different concepts not related should not be highly correlated
    - Courage and Honesty

2. Reliability

- Typically, in any research we use a number of questions (sometimes) referred to as items to measure a particular variable
- Example: in the
    - Information Sharing reward1-5 measures REWARD and the others
    - Issue: How good are these items to measure the variables of interest?
- The above issues relates to Validity and Reliability of Measures

FACTOR ANALYSIS

PURPOSE: Define the underlying structure in a data matrix; analyze the structure of interrelationships among a large number of variables by defining a set of common underlying dimensions called **factors**

STEPS:

Stage 1: **Objectives of Factor Analysis**

- identify structure of relationships; i.e correlation between variables (R factor analysis) or correlation between respondents (Q factor analysis)
- identify representative variables for a much larger set of variables to be used in further analysis (multivariate)
- identifying a new set of variables, much smaller in number to replace the original to be used in subsequent techniques - regression, discriminant, etc.

Stage 2: **Designing the Analysis**:

Three basic decisions:

- Calculation of input data

- Design of study - number of variables, measurement properties of variables and types of variables
- Sample size

- **Input Data:**
  - Correlation among variables - R type factor
  - Correlation among respondents - Q type factor

- **Variables:**
  - assumed to be metric measurements; sometimes dummy
  - Identifying key variables that reflect closely the hypothesized factors

- **Sample Size**
  - Not < 50 cases; preferably > 100: 20 cases/variable

ASSUMPTIONS

- **Normality, Homoscedasticity, Linearity**
  Only diminish the observed correlation

- **Correlation Matrix**
  - Sufficient number of correlation > 0.3
  - Partial corr. small - true factors exist if high - no underlying factors
  - SPSS output: anti-image correlation = negative value of partial correlation
  - Barlett test of Sphericity test existence of significant correlations among variables
  - Measure of Sampling Adequacy - measure degree of intercorrelation among variables; it ranges from 0 - 1; when less than 0.5 it is considered inadequate
  - Separate out subsamples e.g if males & females differ according to the variables, separate factor analysis should be carried out.

DECISIONS

- **Decisions**
  - Method of Extracting Factors
  - Number of Factors

- **Methods of Extracting Factors**
  - Choice is Common Factor or Component Analysis
  - Choice depends on objectives of research and prior knowledge of the variance
  - Common Factor Analysis - if objective is to extract underlying factors and no knowledge of the unique (specific) and error

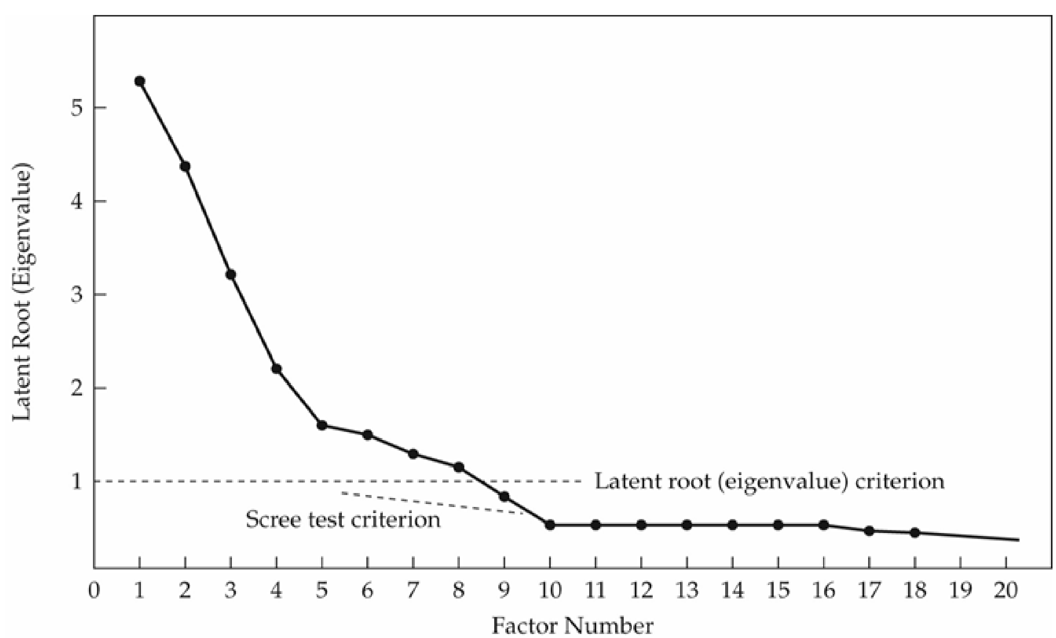
- Component Analysis - if objective is to summarize most of the original information; concern with prediction or minimum number of factors needed to account for the maximum portion of variance in the original set of variables and when the specific and error variance is small.

- **Latent root/eigenvalues criteria**
  - each factor must explain at least one variable ie only factors having eigenvalues at least 1
  - Most common method

- **Apriori Criterion**
  - Analyst fixes the number to be extracted

- **% of Variance**
  - to ensure practical significance
  - no absolute threshold
  - normally at least 60%

- **Scree Test**
  - test that optimally determine when the unique variance begins to dominate
  - plot of eigenvalues vs number of factors (point where plot begin to straighten out)
  - Cattell, R. B. (1966). The scree test for the number of factors, *Multivariate Behavioral Research*, 1(April), 245-276.
  - Cattell, R. B. and Vogelman, S. (1977). A Comprehensive Trial of the Scree and KG Criteria for Determining the Number of Factors, *Multivariate Behavioral Research,* 12, 289 -325.

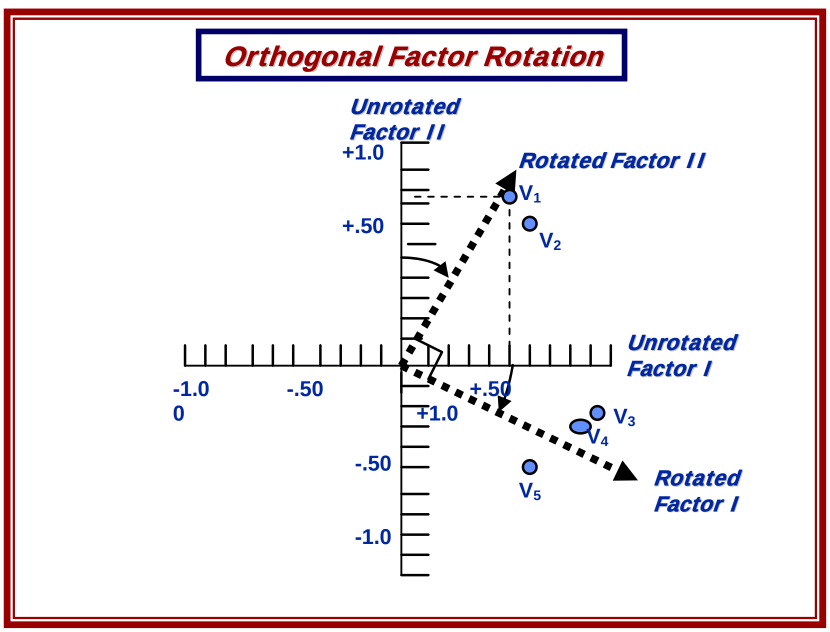


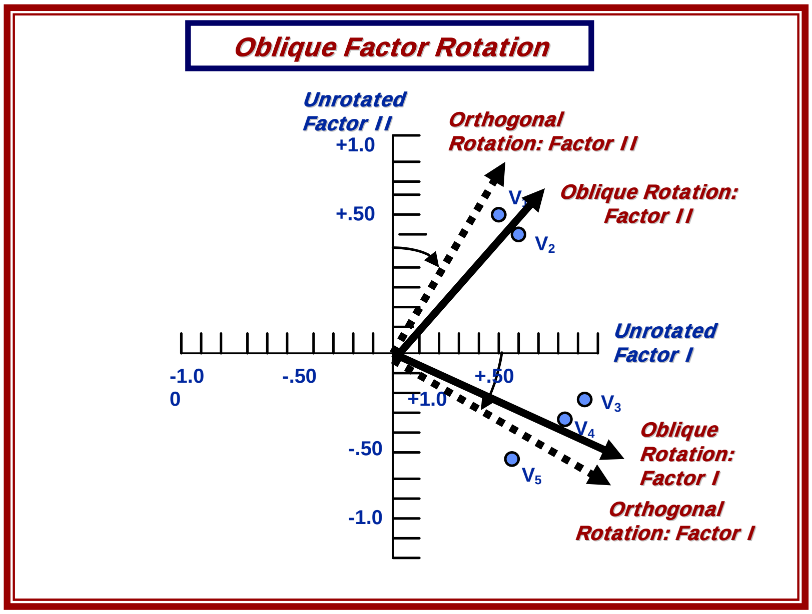
Rotation

- Initial unrotated factors
  - o Best linear combination, 1st the best followed by 2nd. etc.
  - o It achieves data reduction
  - o Factor loadings - correlation between variable and the factor

- If no reasonable interpretation use rotation
  - o Types of rotation - orthogonal
    - Quartimax (simplify rows).
    - Varimax (simplify columns).
    - Equimax (combination).
  - o Non-orthogonal
    - Oblimin

- Respecify Factor Model - due to deletion of variables, desire for different rotation, need to extract different numbers of factors, changing extraction method





Criteria for Loadings Significance

- Rule of Thumb: Loading ± 0.3 this translate to 10% explanation
- Approach like statistical testing of correlation; but loadings has bigger standard error thus loadings evaluated at stricter significance level

- **Guidelines:**
  - Larger sample size, the smaller loading can be considered significant
  - The larger the number of variables, the smaller loadings can be considered significant
  - The larger the number of factors, the larger the size of the loading on later factors to be considered significant for interpretation

Factor Loading	Sample Size Needed
0.30	350
0.35	250
0.40	200
0.45	150
0.50	120
0.55	100
0.60	85
0.65	70
0.70	60
0.75	50

Factor Loading	Rating
>= 0.9	Marvelous
0.80	Meritorious
0.70	Middling
0.60	Mediocre
0.50	Miserable
< 0.50	Unacceptable

Kaiser, H. F. (1970). A second-generation little jiffy, *Psychometrika*, 35, 401-415.
Kaiser, H. F. and Rice, J. (1974). Little jiffy, Mark IV, *Educational and Psychology Measurement*, 34, 111-117

Generalizing to the Population?

- Issues:
  - Replication
  - Stability of factor model results
  - Detection of Influential Observations

- Method:
  - Split sample validation
  - Separate sample validation

Reliability Analysis

- When
  - Before forming composite index to a variable from a number of items

- Interpretation
  - Alpha value greater than 0.7 is good; more than 0.5 is acceptable; delete some items if necessary

Non-Response Bias

According to Harbaugh (2002, p. 70). "Response rates for traditional mail surveys have continued to decline to a point where the average is below 20%." The response rate of 27.71% is actually higher than the normal response rate of 10-20% using the same method in Malaysia. As the respondents for this study are key persons in the organization, they are known to be less likely to respond to mailed questionnaires than people in the general population (Hunt & Chonko 1987).

As suggested by Zou et al. (1997), owing to the lack of comparable data from the non-responding firms, direct comparison of the responding and non-responding firms was not possible. We used the wave analysis method with the Student's t-test as the next best approach to compare between the early and late replies (replies received after the follow up contacts) as suggested by Armstrong and Overton (1977). The wave analysis method assumes that those who respond less readily are more like non-respondents. (Zou et al., 1997). They suggested using the t-test procedure under the assumptions of both equal and unequal group variances. In the t-test analysis, we found no between-group mean differences at the 5% level for any of the variables in the study. Thus, it may be concluded that non-response bias was not of particular influence in this research. (Skarmeas et al., 2002).

Harbaugh, R. (2002), "Proven lessons for generating good mail survey response rates", *Medical Marketing and Media*, Vol 37 No 10, pp. 70-75.

Hunt, S.D. and Chonko, L.B. (1987), "Ethical Problems of Advertising Agency Executives", *Journal of Advertising*, Vol. 53 No 1, pp. 16-24.

Armstrong, S. and Overton, T.S. (1977), "Estimating Nonresponse Bias in Mail Surveys", *Journal of Marketing Research*, Vol 14, pp. 396-402.

Skarmeas, D., Katsikeas, C.K. and Schlegelmilch, B. (2002), "Drivers of commitment and its impact on performance in cross-cultural buyer-seller relationships: the importer's perspective", *Journal of International Business Studies*, Vol. 33 No. 4, pp. 757-83.

Zou, S., Andrus, D.M. and Norvell, D.W. (1997), "Standardization of international marketing strategy by firms from a developing country", *International Marketing Review*, Vol. 14 No 2, pp. 107-123.

Content Validity

Content validity refers to the extent to which an instrument covers the meanings included in the concept (Babbie, 1992). Researchers, rather than by statistical testing, subjectively judge content validity (Chow and Lui, 2001). The content validity of the proposed instrument is at least sufficient because the instrument is carefully refined from a proven instrument with an exhaustive literature review process (Chow and Lui, 2001). This can also be tested during the pre-test by using subjects who are qualified (academicians and practitioners) to rate whether the content of each factor was well represented by the measurement items (Saraph et al., 1989). As Nunnally (1967) put it content validity depends on how well the researchers created measurement items to cover the domain of the variable being measured.

Convergent Validity

Further to the construct validity test using the factor analysis (between scales) another factor analysis but this time using the within scale was utilized to test the convergent validity. According to Campbell and Fiske (1959) convergent validity refers to all items measuring a construct actually loading on a single construct. Convergent validity is established when items all fall into 1 factor as theorized.

A factor analysis with varimax rotation was done to validate whether the respondents perceived the three constructs to be distinct. The results showed a five factor solution with eigenvalues greater than 1.0 and the total variance explained was 78.535% of the total variance. KMO measure of sampling adequacy was 0.801 indicating sufficient intercorrelations while the Bartlett's Test of Sphericity was significant (Chi square= 4057.200, $p < 0.01$). The criteria used by Igbaria et al., 1995 to identify and interpret factors were: each item should load 0.50 or greater on one factor and 0.35 or lower on the other factor. Table 1 shows that result of the factor analysis. These results confirm that each of these constructs is unidimensional and factorially distinct and that all items used to measure a particular construct loaded on a single factor.

Results of the Factor Analysis

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.801
Bartlett's Test of Sphericity	Approx. Chi-Square	4057.200
	df	231
	Sig.	.000

Table 1
Results of factor analysis

	Component				
	1	2	3	4	5
Reward1*	-.337	.104	.083	.033	.028
Reward2	-.016	.081	**.981**	.047	.082
Reward3	-.065	.100	**.981**	.054	.047
Recip1	.232	.309	.005	**.597**	.059
Recip2	.203	.283	.072	**.682**	-.170
Recip3	.132	.169	.197	**.724**	.092
Recip4	.120	.355	-.038	**.698**	.073
Recip5	-.049	.114	-.051	**.826**	.050
Sw1**	**-.956**	.301	.028	.209	.001
Sw2	.012	**.859**	.053	.290	.054
Sw3	-.035	**.890**	.087	.230	.112
Sw4	-.050	**.890**	.144	.211	-.074
Sw5	-.113	**.882**	.058	.164	.098
Ec1	-.058	.059	-.051	-.040	**.891**
Ec2	-.058	.033	.102	.054	**.890**
Ec3	-.048	.049	.101	.092	**.909**
Climate1	**.863**	-.053	-.039	.061	.040
Climate2	**.861**	.089	-.039	.090	-.042
Climate3	**.854**	-.038	-.025	.246	.024
Climate4	**.856**	-.119	.068	.065	.007
Climate5	**.864**	-.092	.054	.010	-.173
Climate6	**.803**	.013	-.158	.092	-.087
Eigenvalue	4.503	4.327	3.033	2.872	2.543
Variance (78.535%)	20.469	19.666	13.785	13.055	11.559

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.791
Bartlett's Test of Sphericity	Approx. Chi-Square	2300.957
	df	231
	Sig.	.000

Rotated Component Matrix(a)

	Component				
	1	2	3	4	5
Reward1	-.074	.087	.058	**.985**	.024
Reward2	-.005	.045	.067	**.982**	.095
Reward3	-.091	.105	.067	**.981**	.043
Recip1	.306	.185	**.608**	.034	.093
Recip2	.200	.252	**.698**	.069	-.056
Recip3	.156	.064	**.754**	.025	.171
Recip4	.072	.323	**.739**	.049	.011
Recip5	.090	.129	**.855**	.044	.041
Sw1	-.065	**.938**	.131	.004	-.021
Sw2	-.023	**.910**	.243	.057	.071
Sw3	-.008	**.877**	.207	.074	.179
Sw4	-.062	**.917**	.209	.094	-.052
Sw5	-.131	**.891**	.132	.070	.115
Ec1	.027	.032	.004	-.015	**.924**
Ec2	-.028	.095	.085	.090	**.879**
Ec3	-.031	.077	.119	.075	**.897**
Climate1	**.866**	-.048	.081	.033	.099
Climate2	**.860**	.069	.151	-.030	.005
Climate3	**.847**	-.071	.290	-.003	.015
Climate4	**.882**	-.097	.114	-.009	-.075
Climate5	**.877**	-.091	.039	.000	-.109
Climate6	**.744**	-.060	.173	-.256	.027

Total Variance Explained

Component	Total	% of Variance	Cumulative %
1	4.519	20.543	20.543
2	4.404	20.017	40.560
3	3.075	13.978	54.538
4	3.011	13.688	68.226
5	2.566	11.664	79.890

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.754
Bartlett's Test of Sphericity	Approx. Chi-Square	1909.719
	df	231
	Sig.	.000

Rotated Component Matrix(a)

	Component				
	1	2	3	4	5
Reward1	.114	-.002	**.978**	.031	-.011
Reward2	.126	-.025	**.978**	.071	-.017
Reward3	.085	-.037	**.979**	.051	.037
Recip1	.575	.130	-.026	-.011	**.416**
Recip2	.420	.235	.083	-.252	**.596**
Recip3	.360	.085	.357	.016	**.666**
Recip4	.501	.202	-.123	.140	**.572**
Recip5	.241	-.193	-.146	.044	**.749**
Sw1	**.861**	-.032	.074	.037	.249
Sw2	**.814**	.060	.053	.044	.273
Sw3	**.931**	-.073	.113	.036	.117
Sw4	**.883**	-.058	.199	-.118	.102
Sw5	**.887**	-.096	.053	.078	.090
Ec1	.108	-.163	-.090	**.845**	-.168
Ec2	-.049	-.096	.109	**.897**	.076
Ec3	.020	-.066	.127	**.915**	.080
Climate1	-.071	**.863**	-.112	-.043	.044
Climate2	.120	**.854**	-.060	-.098	-.020
Climate3	.047	**.876**	-.048	.044	.153
Climate4	-.154	**.830**	.140	.087	.070
Climate5	-.084	**.840**	.107	-.253	-.054
Climate6	.098	**.837**	-.072	-.217	-.043

Total Variance Explained

Component			
	Total	% of Variance	Cumulative %
1	4.895	22.251	22.251
2	4.558	20.719	42.970
3	3.197	14.534	57.504
4	2.608	11.854	69.358
5	2.107	9.577	78.935

Table 2
Results of Factor Analysis

Variables	***Loadings***	***Eigenvalue***	***Variance***	***Reliability***
Expected Reward		**2.950**	**98.333**	**0.991**
Reward1	0.922			
Reward2	0.992			
Reward3	0.991			
Reciprocal Relationship		**2.902**	**58.032**	**0.818**
Recip1	0.729			
Recip2	0.761			
Recip3	0.763			
Recip4	0.788			
Recip5	0.767			
Self Worth		**4.216**	**84.317**	**0.953**
Sw1	0.929			
Sw2	0.906			
Sw3	0.931			
Sw4	0.922			
Sw5	0.903			
Expected Contribution		**2.456**	**81.878**	**0.888**
Ec1	0.884			
Ec2	0.904			
Ec3	0.926			
Climate		**4.420**	**73.675**	**0.928**
Climate1	0.862			
Climate2	0.862			
Climate3	0.879			
Climate4	0.862			
Climate5	0.868			
Climate6	0.816			

Table 3
Result of discriminant validity

Average	ER (0.983)	RR (0.580)	SW (0.843)	EC (0.819)	Climate (0.737)
ER	1				
RR	0.114	1			
SC	(0.013)				
SW	0.185**	0.525**	1		
SC	(0.034)	(0.276)			
EC	0.119	0.071	0.107	1	
SC	(0.014)	(0.005)	(0.011)		
Climate	-0.067	0.245**	-0.064	-0.106	1
SC	(0.004)	(0.060)	(0.004)	(0.011)	

Average= Average variance extracted

Discriminant Validity

Discriminant validity refers to the extent to which measures of 2 different constructs are relatively distinctive, that their correlation values were neither an absolute value of 0 nor 1 (Campbell and Fiske, 1959). A correlation analysis was done on the 5 factors generated and the result is presented. As can be seen all the factors are not perfectly correlated where their correlation coefficients range between 0 or 1. Hence, we can conclude that discriminant validity has been established. A more stringent rule was proposed by Smith et al. (1996) which was that the average variance extracted of a factor is greater than the squared correlation between that and every other factor, the factor exhibit discriminant validity because the average amount of variance extracted by each factor is greater than the associated squared correlations. (Chow and Lui, 2001)

Babbie, E. (1992). *The Practice of Social Research* (6th ed.). Belmont, CA: Wadsworth.

Campbell, D. T. and Fiske, D. W. (1959). *Convergent and discriminant validation by the multitrait –multimethod matrix*. Psychological Bulletin, 56(1), pp. 81-105.

Chow, W. S. and Lui, K. H. (2001). *Discriminating factors of information systems function performance in Hong Kong firms practicing TQM*. International Journal of Operations and Production Management, 21(5/6), pp. 749-771.

Igbaria, M., Iivari, J. and Maragahh, H. (1995). *Why do individuals use computer technology? A Finnish case study*. Information and Management, 5, pp. 227-238.

Nunnally, J. C. (1967). *Psychometric theory*, New York: McGraw-Hill.

Table 4

Correlations between the main variables with intention to share information

	Reward	Reciprocal	Selfworth	Ec	Climate
Intention	.124*	.744**	.557**	-.097	.147*

Criterion related validity refers to the extent to which the factors measured are related to pre-specified criteria (Saraph et al., 1986). This is also called as nomological validity or external validity. From the table above we can see that all the factors are positively related to intention to share except for EC, thus demonstrating criterion-related validity. We can also do this by running a multiple regression analysis and looking at the Multiple R value (correlation coefficient), the values we are looking for are any values higher that 0.5.

Saraph, J.V., Benson, P.G. and Schroeder, R.G. (1989). An instrument for measuring the critical factors of quality management, *Decision Sciences*, Vol 20, pp. 810-829.

Table 5
Reliability of major variables

Variables	Number of Items	Items deleted	Reliability
Expected Reward	3	-	0.991
Reciprocal Relationship	5	-	0.818
Self Worth	5	-	0.953
Expected Contribution	3	-	0.888
Climate	6	-	0.928
Intention to Share	5	-	0.966

Reliability

Reliability refers to the degree of consistency, as Kerlinger (1986) puts it; if a scale possesses a high reliability the scale is homogeneous. According to Nunnally (1978) alpha values equal to or greater than 0.70 are considered to be a sufficient condition. Thus, it can be concluded that these measures possess sufficient reliability.

Nunnally (1978, p. 245) recommends that instruments used in basic research have reliability of about .70 or better. He adds that increasing reliabilities much beyond .80 is a waste of time with instruments used for basic research. On the other hand, with instruments used in applied settings, a reliability of .80 may not be high enough. Where important decisions about the fate of individuals are made on the basis of test scores, reliability should be at least .90, preferably .95 or better.

Nunnally (1978, p. 244), shows how to calculate how many additional items one would need to raise the reliability of an instrument to the desired value (assuming that the additional items are as good as the items already on hand).

$k = \frac{r_d(1-r_e)}{r_e(1-r_d)}$, where r_d is the desired reliability, r_e is the reliability of the existing instrument, and k is the number of times the test would have to be lengthened to obtained the desired reliability. For example, suppose you have a 5 item test whose reliability is .66. To raise the reliability to .70, $k = \frac{.7(1-66)}{.66(1-.7)} = 1.2.$ Thus, you would need a test with 1.2(5) = 6 items. To raise the reliability to .75, k = 1.5, you would need 7 or 8 items. To raise the reliability to .80, k = 2.06, you would need 10 or 11 items.

The Wikipedia says that:

As a rule of thumb, a proposed psychometric instrument should only be used if an α value of 0.8 or higher is obtained on a substantial sample. However the standard of reliability required varies between fields of psychology: cognitive tests (tests of intelligence or achievement) tend to be more reliable than tests of attitudes or personality. There is also variation within fields: it is easier to construct a reliable test *of a specific attitude than of a general one, for example.* -- en.wikipedia.org/wiki/Cronbach%27s_alpha

Cronbach's Alpha is a measure of how well each individual item in a scale correlates with the sum of the remaining items. It measures consistency among individual items in a scale. Streiner and Normal offer this advice on Cronbach's Alpha.

It is nearly impossible these days to see a scale development paper that has not used alpha, and the implication is usually made that the higher the coefficient, the better. However, there are problems in uncritically accepting high values of alpha (or KR-20), and especially in interpreting them as reflecting simply internal consistency. The first problem is that alpha is dependent not only on the magnitude of the correlations among items, but also on the number of items in the scale. A scale can be made to look more 'homogenous' simply by doubling the number of items, even though the average correlation remains the same. This leads directly to the second problem. If we have two scales which each measure a distinct construct, and combine them to form one long scale, alpha would probably be high, although the merged scale is obviously tapping two different attributes. Third, if alpha is too high, then it may suggest a high level of item redundancy; that is, a number of items asking the same question in slightly different ways. -- pages 64-65, **Health Measurement Scales A Practical Guide to Their Development and Use.** Streiner DL, Norman GR (1989) New York: Oxford University Press, Inc.

Kerlinger, F. N. (1986). *Foundations of Behavioral Research.* Texas: Rinehart and Winston.

Nunnally, J. C. (1978). *Psychometric Theory.* New York: McGraw Hill.

A. IS OUR SAMPLE REPRESENTATIVE – NON-RESPONSE BIAS

Is our sample representative of the population?
Is the impact of non-response serious?

TECHNIQUES: Descriptive – Cross-tabulations

Consider the responses beyond a certain number to be late responses.

- Is our sample representative? - Compare the sample profile

  In comparing the demographic profiles of the early and late responses, it is noted that there is little difference in terms of education (76% for early responses compared to 81% for late responses having Bachelors degree) and position in the organization (with 63% for early responses compared to 70% for late responses from lower management).

  Similarly, the profiles of the responding companies show little variation between late and early responses. In terms industry 46% are from the E&E sector for early responses compared 49% for late responses. Proportion of European and North American companies amongst the late responses is slightly higher to that of early responses. Size-wise in terms of number of employees, the slight differences in proportions occur for small and very large companies – with the late responses having smaller proportion of very large companies and higher proportion of small companies compared to the early responses. The same pattern appears for size in terms of gross revenue. Activity-wise, both early and late responses have almost similar proportions in services and manufacturing.

  On the whole, one can argue that there is little significant difference in the demographic profiles of the early and late responses; thus we can conclude that the sample is representative of the population of interest. The minor difference in terms of size may be statistically significant and have impact on the inference. This will be addressed next.

SAMPLE PROFILE

Table 1: Sample Profile – Overall, Early and Late Responses						
RESPONDENTS' PROFILE	OVERALL SAMPLE N=123		EARLY RESPONSE N = 80		LATE RESPONSE N = 43	
EDUCATION LEVEL	NO.	PERCENT	NO.	PERCENT	NO.	PERCENT
Masters or Higher	15	12.20	6	7.5	9	20.93
Bachelors Degree	94	76.42	65	81.25	29	67.44
Diploma or lower	14	11.38	9	11.25	5	11.63
POSITION						
Middle & Upper Management	43	34.96	30	37.5	13	30.23
Lower Management	80	65.04	50	62.5	30	69.77
COMPANIES' PROFILE						
INDUSTRY						
Electrical and Electronics	56	45.53	35	43.75	21	48.84
Non-Electrical & Electronics	67	54.47	45	56.25	22	51.16
COUNTRY OF ORIGIN						
European	25	20.33	10	12.5	15	34.88
North America	27	21.95	13	16.25	14	32.56
Asian	28	22.76	26	32.5	2	4.65
Local	43	34.96	31	38.75	12	27.91
SIZE (NO. OF FULL-TIME EMPLOYEES)						
less than 500	36	29.27	27	33.75	9	20.93
500 - 999	22	17.89	15	18.75	7	16.28
1000 - 2000	29	23.58	19	23.75	10	23.26
more than 2000	36	29.27	19	23.75	17	39.53
SIZE (ANNUAL GROSS REVENUE)						
Less than USD 10 million	43	34.96	30	37.5	13	30.23
Between USD 10 to USD 50 million	31	25.20	25	31.25	6	13.95
more than USD 50 million	49	39.84	25	31.25	24	55.81
BUSINESS ACTIVITY						
Services	27	21.95	18	22.5	9	20.93
Manufacturing	96	78.05	62	77.5	34	79.07

IMPACT OF NON-RESPONSE BIAS

Compare the major variables of the study – early vs. late responses.

TECHNIQUES: Compare Means - Means

Table 2 summarizes the mean and standard deviations of the major variables of study for overall sample, early and late responses.

In terms of innovation and its various dimensions, clearly the mean levels for the early responses are higher than that of the late responses, with the differences ranging from a low of 0.2 to a high of 0.62, averaging at 0.4. How significant these differences are can be established in test of differences.

In terms of cultural values, the early responses are consistently lower compared to late responses, with the differences ranging from a low of 0.02 to a high of 0.31, and averaging at 0.14. However, for structural values, there is no consistent pattern; early responses are lower in terms of centralization but higher in formalization.

How serious are these differences? This question can be addressed by statistically testing for the significance of these differences before any formal declaration can be made as to whether the impact of non-response bias can distort the overall inference of the data.

Table 2: Non-Response Bias

VARIABLE	OVERALL SAMPLE		EARLY RESPONSE		LATE RESPONSE	
	MEAN	STD. DEV.	MEAN	STD. DEV.	MEAN	STD. DEV.
1. Overall Innovation	2.76	0.61	2.91	0.56	2.49	0.60
2. Technological & Process Innovation	2.68	0.78	2.84	0.77	2.38	0.72
3. Administrative Innovation	2.73	0.75	2.88	0.71	2.47	0.76
4. Product Innovation	2.84	0.91	3.06	0.89	2.43	0.81
5. Speed of Innovation	2.75	0.75	2.86	0.73	2.54	0.74
6. Radicalness of Innovation	2.85	0.66	2.92	0.64	2.72	0.69
Culture						
7. Learning & Development	3.31	0.90	3.28	0.92	3.37	0.87
8. Participation in Decision-making	2.52	0.68	2.41	0.68	2.72	0.63
9. Support and Collaboration	3.58	0.73	3.57	0.71	3.59	0.78
Structure						
10. Centralization	2.11	0.93	2.00	0.90	2.31	0.97
11. Formalization	2.78	0.88	2.86	0.87	2.64	0.90

Issue: Are the differences in each of the main variables of the study significant different between early and late responses? (This we will do in Test of Differences)

B. WHAT IS THE CURRENT STATE OF AFFAIR FOR THE VARIABLES OF INTEREST

- ❖ What is the current level of the variables of interest?

TYPICAL QUESTIONS

- ❖ How innovative are Malaysian companies?
- ❖ What kind of organizational structure currently in place in Malaysian companies?
- ❖ What kind of culture is pervasive in Malaysian companies?

TECHNIQUES: Descriptive - descriptives

Table 2 presents the overall descriptive statistics of the structural values, cultural values and the levels of innovativeness and its dimensions.

Bearing in mind that the scale of measurement is descending from 1 to 5, the mean level of overall innovation (2.76) and its dimensions are slightly below 3 indicating a moderate level of innovativeness. Another point of note is that the levels do not seem to differ greatly from one type of innovation to the other.

In terms of cultural values, the companies are high on support and collaboration (mean = 3.58), followed by learning and development (mean = 3.31), and low on participation in decision-making (mean = 2.52). The high learning and development and support and collaboration is reflective of the current business environment, where teamwork and development through training. However, participation in decision-making is still lacking, reflecting the hierarchical structure of many Malaysian organizations.

Structurally, Malaysian organization are still quite centralized (mean = 2.11) where decision-making resides with senior and top executives, and moderately formalized (mean = 2.78).

The above reflects the general situation; differences do occur across sizes, country of origin, industry and business activity. This will be explore in the next section.

1. **DESCRIPTIVE ANALYSIS**

PURPOSE:
- Describe the distribution of the variable of interest.

TECHNIQUES:
- Frequencies and Cross-tabulations for Nominal or Categorical Variables
- Means and Means by sub-groups for Continuous Data

WHEN DO WE USE THEM IN THE RESEARCH?
- Describing the Sample Profile
- Issue of Representativeness - Non-Response Bias

2. **TEST OF DIFFERENCES**

PURPOSE:
- To test whether a variable of interest differ significantly across 3 or more sub-groups of the population, or
- To test whether 2 or more subgroups of the population differ in terms of one or more variable of interest, or
- To test whether 2 or more variables are rated differently by the population.

WHEN:
- To establish whether two or more groups are statistically significantly different in terms of a particular variable of interest.
- To establish whether two or more variables are rated significantly different by the population. This is to establish definite ranking/ordering

TECHNIQUES:
- Parametric Techniques: t-test; paired t-test, 1-way ANOVA, 2-way ANOVA
- Non-Parametric Techniques: Mann-Whitney/ Wilcoxon rank sum test; Wilcoxon signed rank sum test, Kruskal Wallis; Friedman test

3. **ESTABLISHING RELATIONSHIPS**

PURPOSE:
- To establish dependence (cause-effect) relationships between two or more variables
- To establish inter-relationships between two or more variables.

TECHNIQUES:
- Dependence Relationships
  - Multiple Regression
  - Discriminant Analysis
- Non-dependence Relationships
  - Correlation – Canonical Correlations
  - Factor Analysis

PROFILING THE RESPONDENTS

1. DESCRIPTIVE ANALYSIS

PURPOSE:

- Describe the distribution of the variable of interest.

TECHNIQUES:

- Frequencies and Cross-tabulations for Nominal or Categorical Variables
- Means and Means by sub-groups for Continuous Data

WHEN DO WE USE THEM IN THE RESEARCH?

- Describing the Sample Profile
- Issue of Representativeness – Response Rate versus Non-Response Bias

a. Response Rates

In any report the first thing that is normally reported is the response rates. In any typical mail survey we should always remember that to get a response rate of 100% is nearly impossible. In the Malaysia context the response rates for mail survey is usually 10-20% only.

Table 1
Response rate

	Number/Frequency
Number of Questionnaires distributed	500
Number of questionnaire returned	120
Response rate	24%
Number of usable questionnaire	98
Effective Response rate	19.6%

There is a difference between response rate and effective response rate. The response rate is equal to the number of questionnaires received divided by the number of questionnaires sent out. The effective response rate on the other hand is equal to the number of usable questionnaire divided by the total number sent out.

Why is this necessary?

When the response rate is low it raises question about the representativeness of the sample. We might have say a majority of small sized companies but our research objectives says that we would like to study small and medium sized enterprises. This by itself points to some sort of bias which needs to be highlighted later in the limitations of the study.

Another reason is the problem of non response. Would the responses of those who have not responded be different form those who responded? This can only be tested if we know the profile of the companies that have not responded or else this would be impossible to do. We can also justify this by doing a "wave analysis" as suggested by Armstrong and Overton (1977), which will be discussed later.

According to Harbaugh (2002, p. 70). "Response rates for traditional mail surveys have continued to decline to a point where the average is below 20%." The response rate of 19.6% matches the usual response rate of 10-20% using the same method in Malaysia. As the respondents for this study are key persons in the organization, they are known to be less likely to respond to mailed questionnaires than people in the general population (Hunt & Chonko 1987).

Harbaugh, R. (2002), "Proven lessons for generating good mail survey response rates", *Medical Marketing and Media*, Vol 37 No 10, pp. 70-75.

Hunt, S.D. and Chonko, L.B. (1987), "Ethical Problems of Advertising Agency Executives", *Journal of Advertising*, Vol. 53 No 1, pp. 16-24.

Armstrong, S. and Overton, T.S. (1977), "Estimating Nonresponse Bias in Mail Surveys", *Journal of Marketing Research*, Vol 14, pp. 396-402.

b. **Who are our respondents?**

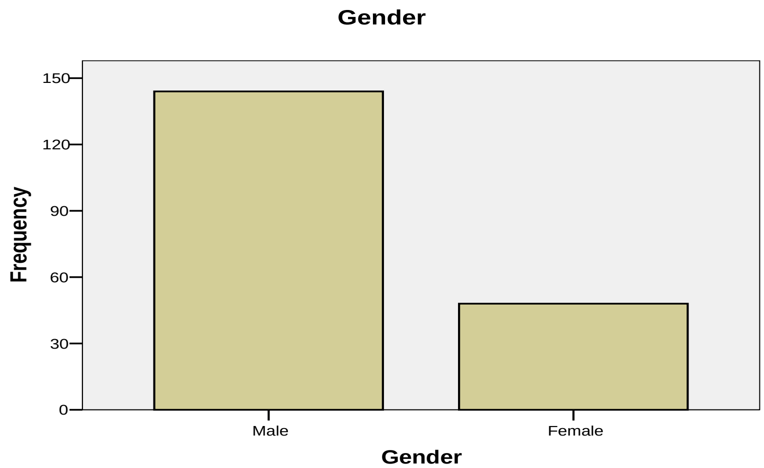
In any report typically there will be a description of the profile of respondents. This is done to highlight that the profile suits the purpose of the study and also if it does not it can be used later to justify the non significance of some research hypotheses.

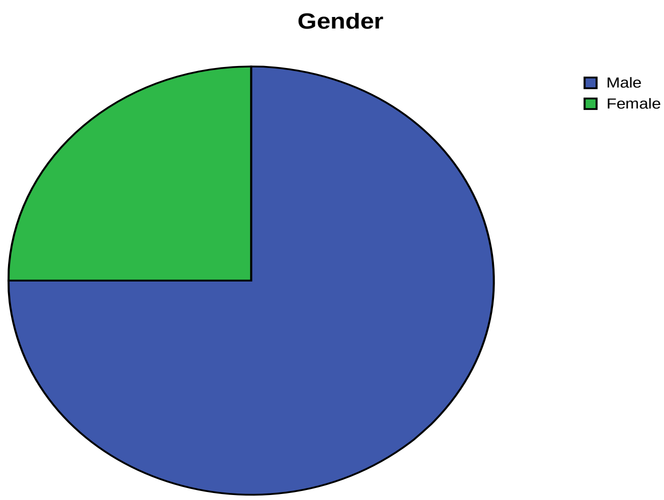
To do this we will ask for the frequency distribution of the nominal variables that we included in the profile section of our questionnaire.

Analyze → Descriptive Statistics → Frequencies

Gender

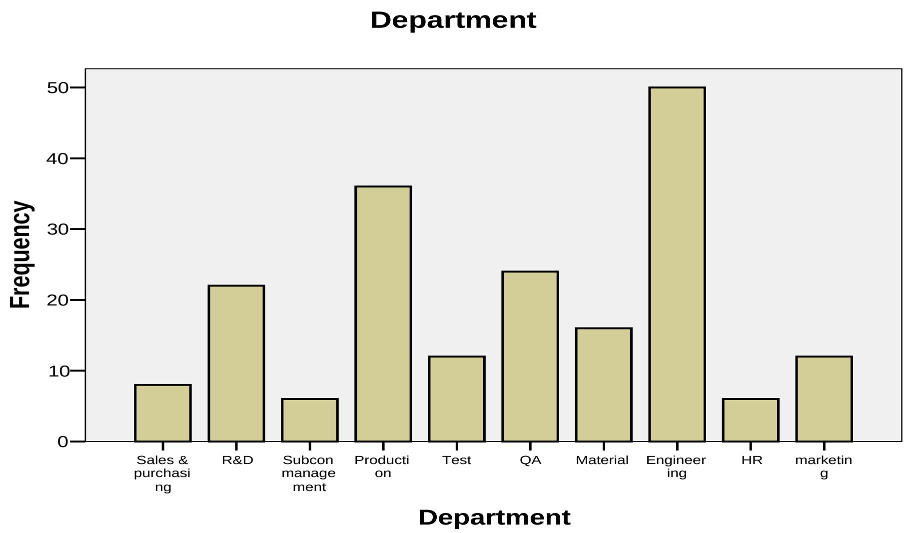
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	144	75.0	75.0	75.0
	Female	48	25.0	25.0	100.0
	Total	192	100.0	100.0	





Department

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sales & purchasing	8	4.2	4.2	4.2
	R&D	22	11.5	11.5	15.6
	Subcon management	6	3.1	3.1	18.8
	Production	36	18.8	18.8	37.5
	Test	12	6.3	6.3	43.8
	QA	24	12.5	12.5	56.3
	Material	16	8.3	8.3	64.6
	Engineering	50	26.0	26.0	90.6
	HR	6	3.1	3.1	93.8
	marketing	12	6.3	6.3	100.0
	Total	192	100.0	100.0	



If we have 10 nominal variables we will be getting 10 different tables like the ones above. We can also charts like the bar chart or the pie char as above. You do not need both in the report. The idea is that for academic report normally tables are used whereas for business presentation charts are more suitable. Kindly refrain from “cut and paste” syndrome. You will need to draw a frequency table like the one below.

Table 2
Profile of respondents

	Frequency	Percentage
Gender		
Male	144	75.00
Female	48	25.00
Department		
Sales & purchasing	8	4.20
R&D	22	11.5
Subcontract Management	6	3.10
Production	36	18.8
Test	12	6.30
Quality Assurance	24	12.50
Material	16	8.30
Engineering	50	26.00
HR	6	3.10
Marketing	12	6.30
Age Group		
27 and below	56	29.2
28 – 35	70	36.5
Above 35	66	34.4
Experience		
1 - 2 years	50	26.0
3 - 5 years	70	36.5
More than 5 years	72	37.5

Table 2 summarizes the demographic profile of the respondents. In terms of respondents, almost 75% were male and they came from various departments although a bigger majority was from the Engineering department. Thus, we can conclude that the respondents are sufficiently well versed with the company and able to comprehend the needs of the questionnaire.

- Do not repeat the information contained in the Table 2. For example – “There are 75% male whilst the remaining 25% were female”. This statement does not bring to bear any new information, not already contained in the Table – thus translating it into prose form is futile.

- When writing the description, pick the pattern that is supporting the arguments that your sample is appropriate to the subject of the study and that the data are obtained from credible sources.
- The whole idea of having the sample profile is to ensure that data thus obtained from the sample you obtained, is credible and therefore provide useful basis for the subsequent analysis and inference.

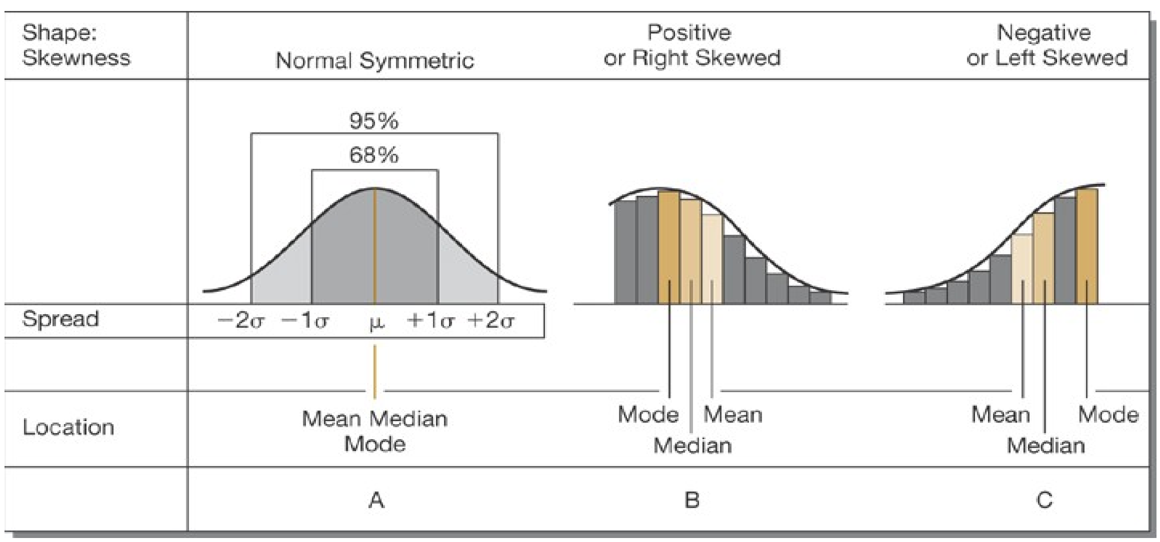
1. Frequency Analysis

   All nominal variables are profiled in a table to show the profile of the respondents or responding companies.

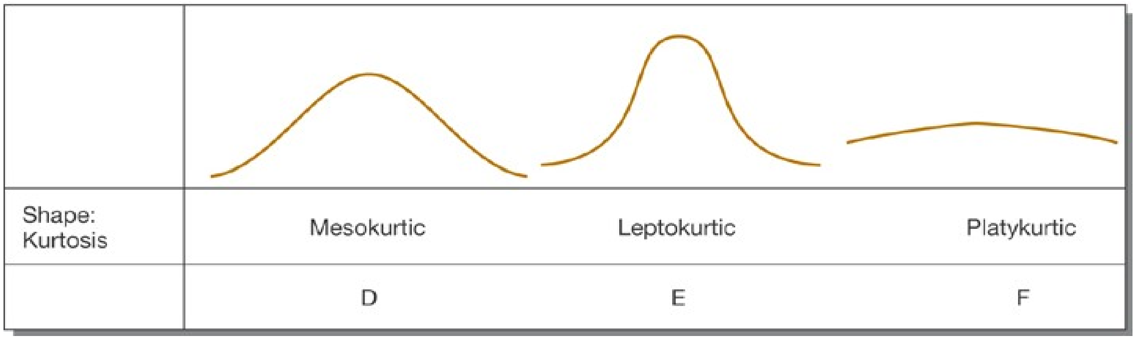
   Who are our respondents?

2. Descriptive analysis

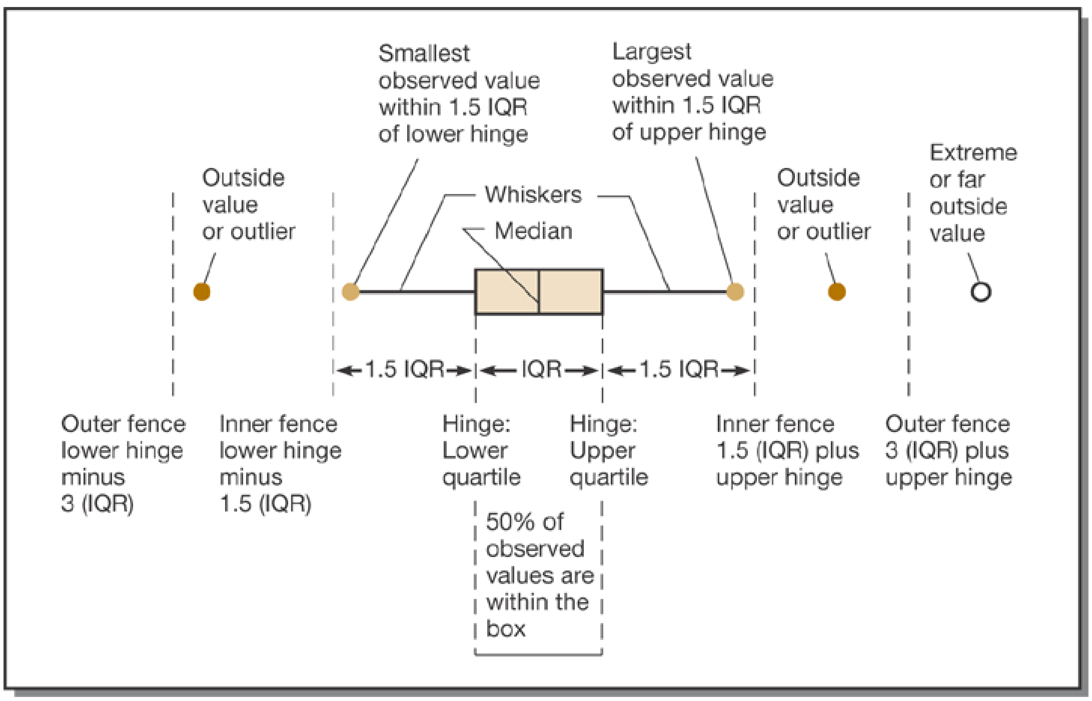
   Histogram
   Mean and Standard deviation
   Skewness and Kurtosis



Positive Skew = sk number +
Negative Skew = sk number -



Mesokurtic = 0
Leptokurtic = +
Platykurtic = -



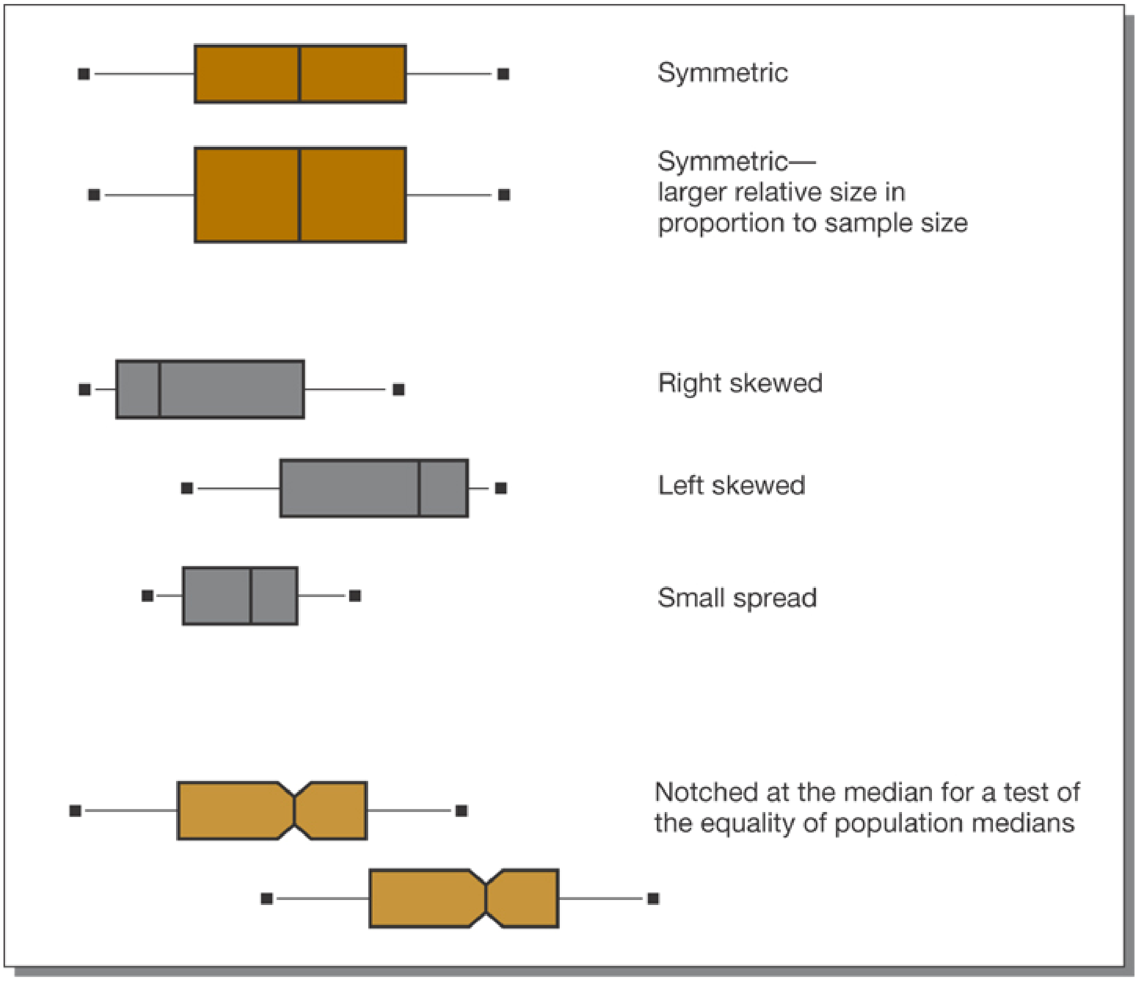


Table 1 summarizes the demographic profile of both the respondents. In terms of respondents, almost 90% had a Bachelor's degree or higher, and about 35% are holding middle and upper level management. Thus, we can conclude that the respondents are sufficiently well versed with their company operations and able to comprehend the needs of the questionnaire.

- Do not repeat the information contained in the Table 1. For example – "There are 35% from the services sector whilst the remaining 65% are from the manufacturing sector". This statement does not bring to bear any new information, not already contained in the Table – thus translating it into prose form is futile.
- When writing the description, pick the pattern that is supporting the arguments that your sample is appropriate to the subject of the study and that the data are obtained from credible sources.
- The whole idea of having the sample profile is to ensure that data thus obtained from the sample you obtained, is credible and therefore provide useful basis for the subsequent analysis and inference.

Exercise 1:

Complete the table with the other demographic profile characteristics of the respondents.

Question:

Is our sample representative?

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	192	19	53	33.39	8.823
Years working in the organization	192	1	18	5.36	4.435
Total years of working experience	192	1	28	9.04	7.276
Valid N (listwise)	192				

We must also remember that not all demographic variables are nominal in nature. For example in our questionnaire, age, organizational tenure and work tenure were actual number of years not in terms of interval classes as such a frequency analysis would be futile.

We would ask for a descriptive analysis where the mean and standard deviation of the variables would be noted. The proper table is presented below.

Table 3
Descriptive profile of respondents

Variable	Mean	Standard Deviation
Age	33.39	8.823
Organizational tenure	5.36	4.435
Work tenure	9.04	7.276
Reciprocal Relationship	3.36	0.56
Self worth	3.74	0.63
Expected Contribution	3.18	0.35
Climate	3.43	0.73
Intention	3.82	0.64
Reward	2.57	0.89

Discussion:

A short description should be written to explain the table like this. For age (M = 33.39, SD = 8.823) suggests that the workforce in this company is young with organizational tenure (M = 5.36, SD = 4.435) which shows that most were still in the first few years of their employment with this company whereas the work tenure (M = 9.04, SD = 7.276) suggests that the workforce may be very mobile with movement from job to job.

c. **What is the Current State of Affair for the Variables of Interest?**

- What is the current level of the variables of interest?

TYPICAL QUESTIONS

- What is the level of intention to share information in the organization?
- What is the level of actual sharing in the organization?

To do this we will ask for the descriptive analysis of the continuous variables that we computed from our questionnaire.

Analyze ⟶ Descriptive Statistics ⟶ Descriptives

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Actual	192	2.33	5.00	4.0625	.58349
Intention	192	2.00	5.00	3.8188	.63877
Valid N (listwise)	192				

Table 4 presents the descriptive statistics of the intention to share and actual sharing in the organization

Table 4

Descriptive profile of respondents

Variable	Mean	Standard Deviation
Intention to share	3.82	0.639
Actual sharing	4.06	0.583

Discussion:

Intention to share information (M = 3.82, SD = 0.639) suggest that the workforce in this company have high intention to share information. An examination of actual sharing (M = 4.06, SD = 0.583) also shows that they do actually share information among the colleagues in the same organization.

The above reflects the general situation; differences do occur across position, department, gender, position and educational level. This will be explored later.

Exercise 2:

Complete the table with the other main variables of the study and a short description of each variable.

d. **χ^2 Test** (**Crosstabulation)**

Chi Square tests can be divided into 2 types:

- Test for independence
  - This test is used when you wish to explore the relationship between 2 categorical variables with each having 2 or more categories
  - Example "Is the proportion of male employees with high intention to share information the same as the proportion of female with high intention to share information?"
  - Gender has (1= Male/2=Female) whereas Level we have (1=Low/2=High)
  - We will have a (2 X 2) contingency table
- Goodness of Fit
  - This test is used to see if a given distribution follows a theoretical distribution say a normal, binomial or whatever distribution.

To use the test for independence we will ask for the descriptive analysis and then select crosstabs and use the variables gender and position in the analysis.

Analyze → Descriptive Statistics → Crosstabs

Gender * Intention Level Crosstabulation

			Intention Level		Total
			Low	High	
Gender	Male	Count	110	34	144
		% within Gender	76.4%	23.6%	100.0%
		% within Intention Level	70.5%	94.4%	75.0%
		% of Total	57.3%	17.7%	75.0%
	Female	Count	46	2	48
		% within Gender	95.8%	4.2%	100.0%
		% within Intention Level	29.5%	5.6%	25.0%
		% of Total	24.0%	1.0%	25.0%
Total		Count	156	36	192
		% within Gender	81.3%	18.8%	100.0%
		% within Intention Level	100.0%	100.0%	100.0%
		% of Total	81.3%	18.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8.934[b]	1	.003		
Continuity Correction[a]	7.704	1	.006		
Likelihood Ratio	11.274	1	.001		
Fisher's Exact Test				.002	.001
Linear-by-Linear Association	8.888	1	.003		
N of Valid Cases	192				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.00.

The Continuity Correction value represents the Yates Correction for Continuity, this value is designed to correct or compensate for what some writers feel is an overestimate of the chi-square value when used with a 2 X 2 table. (Pallant, 2001)

Assumption:

The lowest expected frequency in any cell should be 5 or more. Some authors suggest a less stringent criterion: at least 80 percent of cells should have expected frequencies of 5 or more (Pallant, 2001). The assumption is tested by looking at the (b) which gives us the % of cells with expected values less than 5. If the value exceeds 20% then this test is not valid.

Pallant, J. (2001). *SPSS Survival Manual: A step by step guide to data analysis using SPSS for Windows (Version 10)*, NSW, Australia: Allen & Unwin.

Table 5
Percentage Distribution of Low and High Intention to share Information

Variable		%		n	χ^2
		Low	**High**		
Gender	Male	76.4	23.6	144	7.704^{***}
	Female	95.8	4.2	48	

Note: *** p < 0.01, ** p < 0.05 and * p < 0.1

Discussion:

The χ^2 value of 7.704 (p< 0.01) indicates that intention to share information is not independent of gender. We can see that for males, 23.6% have high intention to share compared to only 4.2% among female. Thus we can conclude that male employees have higher intention to share.

Exercise 3:

Test whether the level of intention to share is independent of department, position and education level.

d. **Problem of Non-Response Bias**

Non response Bias is a test to determine whether responses of those who have not responded are different from those who responded? This can only be tested if we know the profile of the companies that have not responded or else this would be impossible to do. We can also justify this by doing a "wave analysis" as suggested by Armstrong and Overton (1977), which will be discussed later.

As suggested by Zou et al. (1997), owing to the lack of comparable data from the non-responding firms, direct comparison of the responding and non-responding firms was not possible. We used the wave analysis method with the Student's t-test as the next best approach to compare between the early and late replies (replies received after the follow up contacts) as suggested by Armstrong and Overton (1977). The wave analysis method assumes that those who respond less readily are more like non-respondents. (Zou et al., 1997). They suggested using the t-test procedure under the assumptions of both equal and unequal group variances. In the t-test analysis, we found no between-group mean differences at the 5% level for any of the variables in the study. Thus, it may be concluded that non-response bias was not of particular influence in this research. (Skarmeas et al., 2002).

Harbaugh, R. (2002), "Proven lessons for generating good mail survey response rates", *Medical Marketing and Media*, Vol 37 No 10, pp. 70-75.

Hunt, S.D. and Chonko, L.B. (1987), “Ethical Problems of Advertising Agency Executives”, *Journal of Advertising*, Vol. 53 No 1, pp. 16-24.
Armstrong, S. and Overton, T.S. (1977), "Estimating Nonresponse Bias in Mail Surveys", *Journal of Marketing Research*, Vol 14, pp. 396-402.
Skarmeas, D., Katsikeas, C.K. and Schlegelmilch, B. (2002), “Drivers of commitment and its impact on performance in cross-cultural buyer-seller relationships: the importer's perspective”, *Journal of International Business Studies*, Vol. 33 No. 4, pp. 757-83.
Zou, S., Andrus, D.M. and Norvell, D.W. (1997), “Standardization of international marketing strategy by firms from a developing country”, *International Marketing Review*, Vol. 14 No 2, pp. 107-123.

Note:

During the data collection stage we have to note the early and late responses by using some criteria. Normally we will allow say about 2 months as cut off date for returns after the first posting and then when we send reminders; all the subsequent returns will be classified as late returns. We usually code them say 1=Early and 2=Late. So we have created another new nominal variable called **response**.

Some researchers also do the postings using waves, ie; first wave and second wave. If that is the case then we have to also test the returns of the first wave with those of the second wave.

Gender * Early and Late Respondents Crosstabulation

			Early and Late Respondents		
			Early	Late	Total
Gender	Male	Count	46	98	144
		% within Gender	31.9%	68.1%	100.0%
		% within Early and Late Respondents	74.2%	75.4%	75.0%
		% of Total	24.0%	51.0%	75.0%
	Female	Count	16	32	48
		% within Gender	33.3%	66.7%	100.0%
		% within Early and Late Respondents	25.8%	24.6%	25.0%
		% of Total	8.3%	16.7%	25.0%
Total		Count	62	130	192
		% within Gender	32.3%	67.7%	100.0%
		% within Early and Late Respondents	100.0%	100.0%	100.0%
		% of Total	32.3%	67.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.032[b]	1	.859		
Continuity Correction[a]	.000	1	1.000		
Likelihood Ratio	.032	1	.859		
Fisher's Exact Test				.860	.496
Linear-by-Linear Association	.032	1	.859		
N of Valid Cases	192				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 15. 50.

Table 6

Chi Square test for Early versus Late responses

Variable		%		n	χ^2
		Early	**Late**		
Gender	Male	31.9	68.1	144	0.000
	Female	33.3	66.7	48	
Position	Technician	17.6	82.4	34	8.707
	Engineer	33.3	66.7	66	
	Senior Engineer	29.6	60.4	54	
	Manager	43.8	56.2	32	
	Above Manager	66.7	33.3	6	
Education Level	Diploma	17.6	82.4	34	5.988
	First Degree	36.8	63.2	136	
	Masters	22.2	77.8	18	
	PhD	50.0	50.0	4	
Age Group	27 and Below	28.6	71.4	56	4.839
	28 – 35 years	25.7	74.3	70	
	Above 35 years	42.4	57.6	66	
Organizational Tenure	1 – 2 years	20.0	80.0	50	6.373*
	3 – 5 years	31.4	68.6	70	
	More than 5 years	41.7	58.3	72	

Note: *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$

Discussion:

In comparing the demographic profiles of the early and late responses, it is noted that there is little difference in terms of gender (31.9% early responses from males compared to 33.3% early responses from females). The Chi

Square value of 0.000 suggests that there are no differences at all in the pattern of responses in terms of gender.

On the whole, one can argue that there is little significant difference in the demographic profiles of the early and late responses; thus we can conclude that the sample is representative of the population of interest.

Exercise 4:

Test whether the there are any non-response bias for the other demographic variables of department, position and education level.

e. **Goodness of Fit Test**

The second test that uses the Chi Square is the goodness of fit test. This test is done to ascertain if the sample follows a pre-specified distribution. Let's say we would to test whether the gender follows a Chi square distribution proportion of 50%.

Analyze → Nonparametric Test → Chi-Square

The null hypothesis states that the sample follows a Chi Square distribution with p= 0.5 whereas the alternate says it does not follow this distribution.

Gender

	Observed N	Expected N	Residual
Male	144	96.0	48.0
Female	48	96.0	-48.0
Total	192		

Test Statistics

	Gender
Chi-Square[a]	48.000
df	1
Asymp. Sig.	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 96.0.

Discussion:

Since the p-value < 0.05, thus we accept the alternate that states that the distribution does not follow the stated distribution. This is evident from the distribution as 75% of the samples are males whereas only 25% are females.

If the distribution is followed then we should be getting 50% males and 50% females.

2. TEST OF DIFFERENCES

PURPOSE:

- To test whether a variable of interest differ significantly across 3 or more sub-groups of the population, or
- To test whether 2 or more subgroups of the population differ in terms of one or more variable of interest, or
- To test whether 2 or more variables are rated differently by the population.

WHEN:

- To establish whether two or more groups are statistically significantly different in terms of a particular variable of interest.
- To establish whether two or more variables are rated significantly different by the population. This is to establish definite ranking/ordering

TECHNIQUES:

- Parametric Techniques: t-test; paired t-test, 1-way ANOVA, 2-way ANOVA
- Non-Parametric Techniques: Mann-Whitney/Wilcoxon rank sum test; Wilcoxon signed rank sum test, Kruskal Wallis; Friedman test

a. Test of differences (2 means)- Independent Samples

An independent samples t-test is undertaken when we want to compare the mean value of some continuous variable across two different groups. For example we would like to test whether intention to share information differs by gender, say you hypothesize that male have higher intention to share compared to females. The Gender variable is nominal (independent) whereas the criterion variable intention to share information is continuous (dependent) so we can use a t-test.

Analyze → Compare Means → Independent-Samples T Test

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Intention	Male	144	3.9000	.60302	.05025
	Female	48	3.5750	.68619	.09904

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Intention	Equal variances assumed	3.591	.060	3.122	190	.002	.32500	.10410	.11965	.53035
	Equal variances not assumed			2.926	72.729	.005	.32500	.11106	.10364	.54636

Table 6
Differences in the major variables by gender

Variables	Male (Mean)	Female (Mean)	t-value
Intention to share	3.90	3.58	3.122**
Reward	2.63	2.39	2.141*
Reciprocal Relationship	3.38	3.29	0.949
Self Worth	3.77	3.67	0.975
Expected Contribution	3.18	3.19	-0.319
Climate	3.40	3.52	-1.026

*p<0.05, **p<0.01

Discussion:

An independent samples t-test was conducted to compare the intention to share scores for males and females. There were significant differences in the scores for males (M=3.90, SD=0.60), and females [M=3.58, SD=0.69; t(190)=2.93, p=0.002]. The magnitude of the differences in the means was moderate (eta squared= 0.05).

Effect Size

Effect size is to test if the statistical differences found is truly sufficient and not by chance. Although sometimes the difference is significant, it may be because of the large sample size where very small differences will be significant. Effect size calculates the strength of the association which indicates the relative magnitude of the differences between means. Tabachnick and Fidell (1996, p. 53) described this as “amount of total variance that is predictable from the knowledge of the levels of the independent variable”

One common measure of effect size is eta squared. Eta squared represents the proportion of variance of the dependent variable that is explained by the independent variable (Pallant, 2001). To interpret the strength we can follow the guidelines of Cohen (1988) which is as follows:

- 0.01 = small effect size
- 0.06 = moderate effect; and
- 0.14 = large effect size

Formula:

$$\text{Eta Squared} = \frac{t^2}{t^2 + (N1 + N2 - 2)}$$

$$\text{Eta Squared} = \frac{(3.12)^2}{(3.12)^2 + (144 + 48 - 2)}$$

$$= 0.049$$

Cohen, J.W. (1988). *Statistical power analysis for the behavioral sciences*, Hillsdale, NJ: Lawrence Erlbaum Associates.

Pallant, J. (2001). *SPSS Survival Manual: A step by step guide to data analysis using SPSS for Windows (Version 10)*, NSW, Australia: Allen & Unwin.

Tabachnick, B.G. & Fidell, L.S. (1996). *Using Multivariate statistics*, New York: Harper Collins.

Exercise 5:

Test whether the there are any non-response bias for the main variables by early and late responses.

b. **Test of differences (2 means)- Dependent Samples**

A paired t-test is undertaken when we want to compare the mean value of two continuous variables rated by the same person. Normally it is done as an experimental design like pre/post. Say you want to compare sales **prior** to an advertisement campaign and sales **after** the sales campaign to see how much sales has increased after the sales campaign. In this test the N remains the same whereas for the earlier independent samples t-test, the N becomes divided into 2 categories say male/female.

In our data we have intention to share rated by the respondent and also actual sharing rated by the same respondent as such we can compare to see if the intention and actual sharing differs significantly.

Analyze → Compare Means → Paired-Samples T Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Intention	3.8188	192	.63877	.04610
	Actual	4.0625	192	.58349	.04211

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Intention & Actual	192	.817	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference: Lower	95% Confidence Interval of the Difference: Upper			
Pair 1	Intention - Actual	-.24375	.37326	.02694	-.29688	-.19062	-9.049	191	.000

Table 7
Paired t-test Result

	Mean Paired Difference	Standard Deviation	t value
Intention - Actual	-0.24375	0.37326	-9.049**

* p< 0.05, ** p < 0.01

Formula:

$$\text{Eta Squared} = \frac{t^2}{t^2 + N - 1}$$

$$\text{Eta Squared} = \frac{(-9.05)^2}{(-9.05)^2 + 30 - 1}$$

$$= 0.3$$

Discussion:

A paired sample t-test was conducted to evaluate if the intention to share and actual sharing are significantly different. There is a statistical difference in intention to share and actual sharing (M=3.82, SD=0.64), and females [M=4.06, SD=0.58; t(191)=-9.05, p=0.000]. The magnitude of the differences in the means was large (eta squared= 0.30).

c. **Test of differences (2 means) - Independent Samples Nonparametric**

The Mann-Whitney U test is the equivalent test for an independent samples t-test in **nonparametric** testing. It is undertaken when we want to compare the median value of some continuous variable across two different groups. For example we would like to test whether intention to share information differs by gender, say you hypothesize that male have higher intention to share compared to females. The Gender variable is nominal (independent) whereas the criterion variable intention to share information is continuous (dependent) and if we assume that the distribution is not normal or the sample size is small then we can resort to this test. What this test does is to first convert the continuous variable into ranks and then the mean ranks are compared. We lose some data in this process.

Analyze → Nonparametric Test → 2 Independent Samples

Ranks

	Gender	N	Mean Rank	Sum of Ranks
Intention	Male	144	103.64	14924.00
	Female	48	75.08	3604.00
	Total	192		

Test Statistics[a]

	Intention
Mann-Whitney U	2428.000
Wilcoxon W	3604.000
Z	-3.266
Asymp. Sig. (2-tailed)	.001

a. Grouping Variable: Gender

Discussion:

From the output we can conclude that there are statistical significant differences ($\underline{Z}$=-3.266, $\underline{p}$< 0.01) in terms of intention to share among males and female employees. Males employees have higher intention to share as evidenced by the higher mean rank values.

d. **Test of differences (2 means)- Dependent Samples Nonparametric**

The Wilcoxon Signed Rank Test is the nonparametric equivalent of the paired t-test is undertaken when we want to compare the median value of two continuous variables rated by the same person. Normally it is done as an experimental design like pre/post. Say you want to compare sales **prior** to an advertisement campaign and sales **after** the sales campaign to see how much sales has increased after the sales campaign. In this test the N remains the same whereas for the earlier independent samples t-test, the N becomes divided into 2 categories say male/female.

Analyze ⟶ Nonparametric Test ⟶ 2 Related samples

Ranks

		N	Mean Rank	Sum of Ranks
Actual - Intention	Negative Ranks	18[a]	111.28	2003.00
	Positive Ranks	150[b]	81.29	12193.00
	Ties	24[c]		
	Total	192		

a. Actual < Intention

b. Actual > Intention

c. Actual = Intention

Test Statistics[b]

	Actual - Intention
Z	-8.278[a]
Asymp. Sig. (2-tailed)	.000

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

Discussion:

From the output we can conclude that there are statistical significant differences (Z=-8278, p< 0.01) in terms of intention to share and actual sharing. Intention to share has been rated lower consistently by the respondents as evidenced by the higher positive mean rank values.

e. **Test of differences (> 2 means)- Independent Samples**

A one way ANOVA is used when we want to compare a continuous variable across more than 2 groups which are also called the "between-groups" test.

Analyze → Compare Means → One-Way ANOVA

Descriptives

Intention

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Diploma	34	3.8941	.46771	.08021	3.7309	4.0573	3.00	5.00
First Degree	136	3.8235	.62304	.05343	3.7179	3.9292	2.00	5.00
Master Degree	18	3.5111	.92093	.21706	3.0531	3.9691	2.00	4.40
PHD	4	4.4000	.46188	.23094	3.6650	5.1350	4.00	4.80
Total	192	3.8188	.63877	.04610	3.7278	3.9097	2.00	5.00

Test of Homogeneity of Variances

Intention

Levene Statistic	df1	df2	Sig.
5.884	3	188	.001

ANOVA

Intention

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.251	3	1.084	2.728	.045
Within Groups	74.681	188	.397		
Total	77.933	191			

Post Hoc Tests: Homogeneous Subsets

Intention

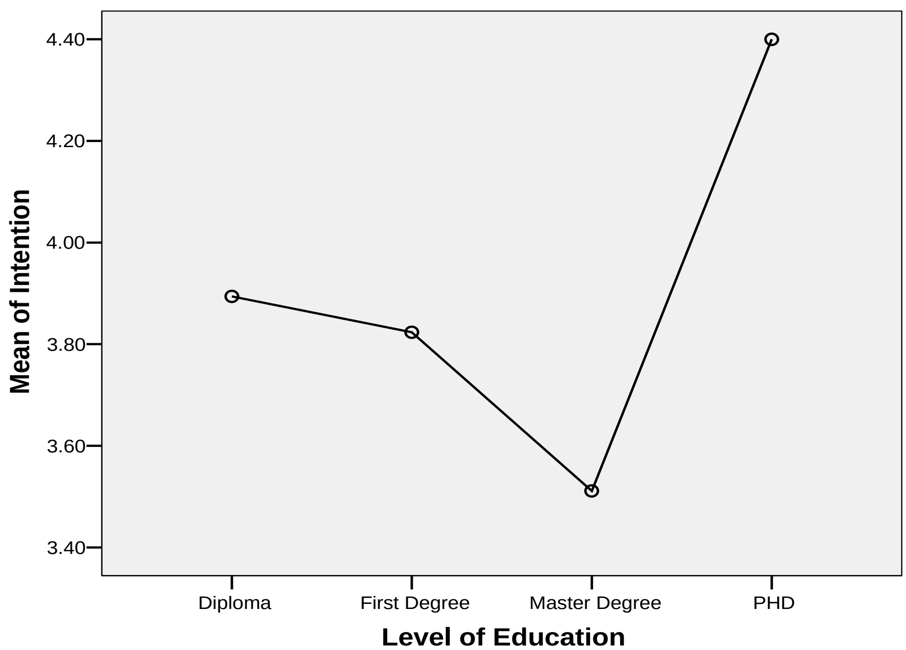
Duncan[a,b]

Level of Education	N	Subset for alpha = .05	
		1	2
Master Degree	18	3.5111	
First Degree	136	3.8235	
Diploma	34	3.8941	3.8941
PHD	4		4.4000
Sig.		.168	.054

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 11.685.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.



Effect Size:

Formula = $\frac{\text{Sum of squares between-groups}}{\text{Total sum of squares}}$

Effect size = $\frac{3.251}{77.933}$

= 0.04

Table 8

Differences in the Intention to share by Educational Level

	Diploma (Mean)	First (Mean)	Masters (Mean)	PhD (Mean)	F value
Intention to share	3.89[a]	3.82[a]	3.51[a]	4.40[b]	2.728*

Means with the same superscripts are not significantly different; means with different superscripts are significantly different at p< 0.05.

	Technician (Mean)	Engineer (Mean)	Senior Eng. (Mean)	Manager (Mean)	Above Manager	F value
Intention to share	3.89[a]	3.64[a]	4.00[a]	3.66[a]	4.55[b]	5.247**

Means with the same superscripts are not significantly different; means with different superscripts are significantly different at p< 0.05.

	27 and below (Mean)	28 - 35 (Mean)	35 and above (Mean)	F value
Intention to share	3.84[a]	3.82[a]	3.80[a]	0.049

Means with the same superscripts are not significantly different; means with different superscripts are significantly different at p< 0.05.

Discussion:

A one-way between-group ANOVA was conducted to test whether intention to share differed by level of education. There was a statistically significant differences at the p< 0.05 level in intention scores for the 4 educational levels [F(3,188) = 2.728, p=0.045]. Despite reaching statistical significance, the actual difference in mean scores between the groups was quite small. The effect size, calculated using the eta squared, was 0.04. Post-hoc comparison using the Duncan's range test indicated that the mean score for Masters (M=3.51, SD=0.92) and First degree (M=3.82, SD=0.62) was statistically different from PhD (M=4.40, SD=0.46). Those with Diploma education (M=3.89, SD=0.47) did not differ statistically from the PhD group.

f. **Test of differences (> 2 means) - Independent Samples Nonparametric**

The Kruskal-Wallis Test is the nonparametric equivalent test for the one way ANOVA. It allows us to compare the scores on a continuous variable across three or more groups. This is also called a "between groups" analysis.

Analyze → Nonparametric Test → k Independent Samples

Ranks

	Level of Education	N	Mean Rank
Intention	Diploma	34	101.32
	First Degree	136	95.47
	Master Degree	18	84.61
	PHD	4	144.00
	Total	192	

Test Statistics[a,b]

	Intention
Chi-Square	4.543
df	3
Asymp. Sig.	.208

a. Kruskal Wallis Test

b. Grouping Variable: Level of Education

Table 9

Differences in the Intention to share by Educational Level

	Diploma (Mean)	First (Mean)	Masters (Mean)	PhD (Mean)	χ^2 value
Intention to share	101.32	95.47	84.61	144	4.543

Means with the same superscripts are not significantly different; means with different superscripts are significantly different at $p < 0.05$.

Discussion:

There are no significant differences in the intention to share among employees with different educational background (χ^2=4.543, $p > 0.01$). This point to the conclusion that employees have the same level of intention to share does not matter what education level they have attained.

g. Test of differences (> 2 means)- Dependent Samples Nonparametric

The Friedman Test is the nonparametric equivalent of the one way repeated measure ANOVA. The idea is to compare say the ratings of several variables by the same respondent to see if there are differences. It is also called repeated measure within subjects test.

Analyze → Nonparametric Test → k Related Samples

Ranks

	Mean Rank
Recip1	3.19
Recip2	2.92
Recip3	2.49
Recip4	3.20
Recip5	3.20

Test Statistics[a]

N	192
Chi-Square	42.830
df	4
Asymp. Sig.	.000

a. Friedman Test

Table 10

Friedman Two-Way ANOVA Result

Mean Rank	Variable
3.19	Reciprocal 1
2.92	Reciprocal 2
2.49	Reciprocal 3
3.20	Reciprocal 4
3.20	Reciprocal 5

Cases	Chi-Square	D.F.	Significance
192	42.8303	4	.0000

Discussion:

There are significant differences in the ratings of the 5 questions by the respondents ($\chi 2$=42.830, p< 0.01). Some of the items are rated much higher as compared to the other items like Reciprocal3 is rated the lowest

Test for Concordance

This is a test to compare if the there is agreement among the respondents in terms of their rating of each of the items. The Kendall's W value will tell us if there is agreement or not. A higher value closer to 1 indicates there is strong agreement whereas a value closer to 0 indicates that there is no agreement at all.

Ranks

	Mean Rank
Recip1	3.19
Recip2	2.92
Recip3	2.49
Recip4	3.20
Recip5	3.20

Test Statistics

N	192
Kendall's W[a]	.056
Chi-Square	42.830
df	4
Asymp. Sig.	.000

a. Kendall's Coefficient of Concordance

Discussion:

The analysis shows that there is little agreement among the raters ($\chi 2=42.830$, $p< 0.01$). This can be inferred from the low value of Kendall's W which is only 0.056.

Exercise 6:

Test whether the there are differences in terms of intention to share and actual sharing across position and department.

3. ESTABLISHING RELATIONSHIPS

PURPOSE:

- To establish dependence (cause-effect) relationships between two or more variables
- To establish the inter-relationships between two or more variables.

TECHNIQUES:

- Dependence Relationships
    - Correlation
    - Multiple Regression
    - Discriminant Analysis

- Non-dependence Relationships
    - Correlation – Canonical Correlations
    - Factor Analysis

a. Correlation

Correlation analysis is used to describe the strength and direction of the linear relationship between 2 variables.

- Pearson – continuous variables
- Spearman – ordinal varaibles

Analyze → Correlate → Bivariate

Strength:

0.10 – 0.29	**Small**
0.30 – 0.49	**Medium**
0.50 – 1.00	**Large**

Correlations

		Intention	Actual	Age
Intention	Pearson Correlation	1	.817**	.016
	Sig. (2-tailed)		.000	.828
	N	192	192	192
Actual	Pearson Correlation	.817**	1	.050
	Sig. (2-tailed)	.000		.489
	N	192	192	192
Age	Pearson Correlation	.016	.050	1
	Sig. (2-tailed)	.828	.489	
	N	192	192	192

**. Correlation is significant at the 0.01 level (2-tailed).

Table 11

Intercorrelations of the variables

	Intention	Actual	Age
Intention	1.000		
Actual	0.817**	1.000	
Age	0.016	0.1050	1.000

*p<0.05, ** p<0.01

Discussion:

There was a strong positive correlation between intention to share and actual sharing [r=0.82, n=192, p<0.01] with high levels of intention associated with high levels of actual sharing.

Correlations

			Intention	Actual	Age
Spearman's rho	Intention	Correlation Coefficient	1.000	.758**	.039
		Sig. (2-tailed)	.	.000	.594
		N	192	192	192
	Actual	Correlation Coefficient	.758**	1.000	.043
		Sig. (2-tailed)	.000	.	.550
		N	192	192	192
	Age	Correlation Coefficient	.039	.043	1.000
		Sig. (2-tailed)	.594	.550	.
		N	192	192	192

**. Correlation is significant at the 0.01 level (2-tailed).

Discussion:

There was a strong positive correlation between intention to share and actual sharing [r=0.76, n=192, p<0.01] with high levels of intention associated with high levels of actual sharing.

Exercise 7:

Test the intercorrelations of the main variables in the study.

Correlations

	reward	reciprocal	selfworth	ec	climate	Intention
Reward	1					
Reciprocal	.114	1				
Selfworth	.185*	.525**	1			
Ec	.119	.071	.107	1		
Climate	-.067	.245**	-.064	-.106	1	
Intention	.124	.744**	.557**	-.097	.147*	1

* p< 0.05, **p< 0.01

b. **Simple Linear Regression**

Simple linear regression is used when we would like to see the impact of a single independent variable on a dependent variable.

Analyze ⟶ Regression ⟶ Linear

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Attitude[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Intention

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.808[a]	.653	.651	.37721

a. Predictors: (Constant), Attitude

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	50.897	1	50.897	357.701	.000[a]
	Residual	27.035	190	.142		
	Total	77.933	191			

a. Predictors: (Constant), Attitude

b. Dependent Variable: Intention

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.771	.163		4.721	.000
	Attitude	.800	.042	.808	18.913	.000

a. Dependent Variable: Intention

Exercise 8:

Run several simple linear regression using expected rewards, reciprocal relationship, expected contribution, self worth and climate as independent variable one at a time against intention to share.

c. Multiple Linear Regression

Multiple linear regression is used when we would like to see the impact of more than one independent variable on a dependent variable.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Norm, Attitude[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Intention

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.818[a]	.669	.665	.36965

a. Predictors: (Constant), Norm, Attitude

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	52.107	2	26.054	190.673	.000[a]
	Residual	25.825	189	.137		
	Total	77.933	191			

a. Predictors: (Constant), Norm, Attitude

b. Dependent Variable: Intention

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.615	.169		3.648	.000
	Attitude	.680	.058	.687	11.768	.000
	Norm	.166	.056	.174	2.976	.003

a. Dependent Variable: Intention

ASSUMPTIONS:

1. Normality
2. Normality of the error terms
3. Linerity
4. Multicollinearity
5. Constant Variance – Homoscedasticity
6. Outliers
7. Independence of the error term

Multiple Linear Regression

Multiple regression analysis is a statistical technique that can be used to analyze the relationship between a single **dependent variable** (continuous) and several **independent variables** (continuous or even nominal). In the case of nominal independent variables, **dummy variables** are introduced.

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + e$$

Where:

	Y	=	Dependent variable
	a	=	Intercept
	b_1, b_2 b_3	=	regression coefficients (slope)
	X1, X2, X3	=	Independent variables
	e	=	random error

Things to consider:

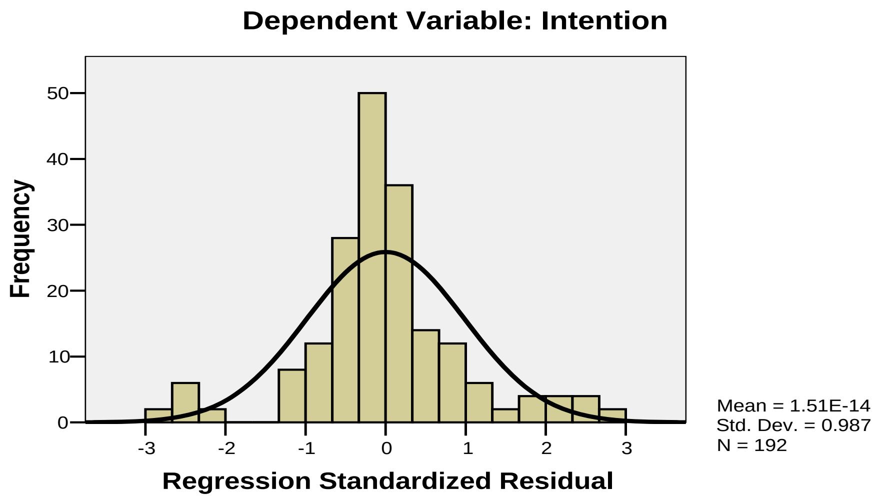
1. Strong Theory (conceptual or theoretical)
2. Measurement Error
   The degree to which the variable is an accurate and consistent measure of the concept being studied. If the error is high than even the best predictors may not be able to achieve sufficient predictive accuracy.
3. Specification error
   Inclusion of irrelevant variables or the omission of relevant variables from the set of independent variables.

ASSUMPTIONS:

1. Normality

   One of the basic assumptions is the normality which can be assessed by plotting the histogram. If the histogram shows not much deviation then we can assume the data follows a normal distribution.

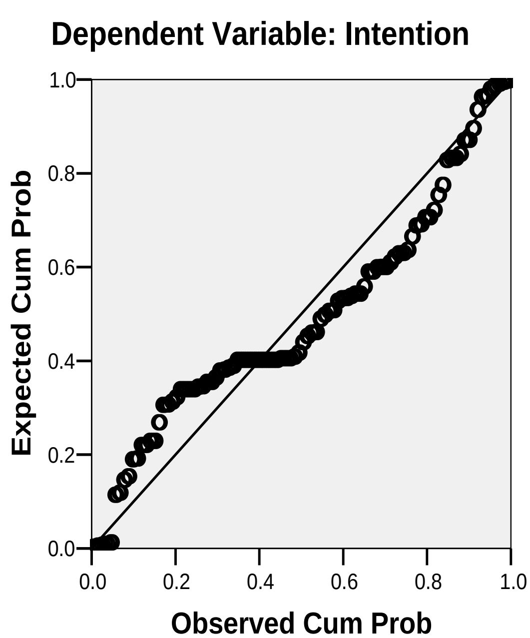
Histogram



2. Normality of the error terms

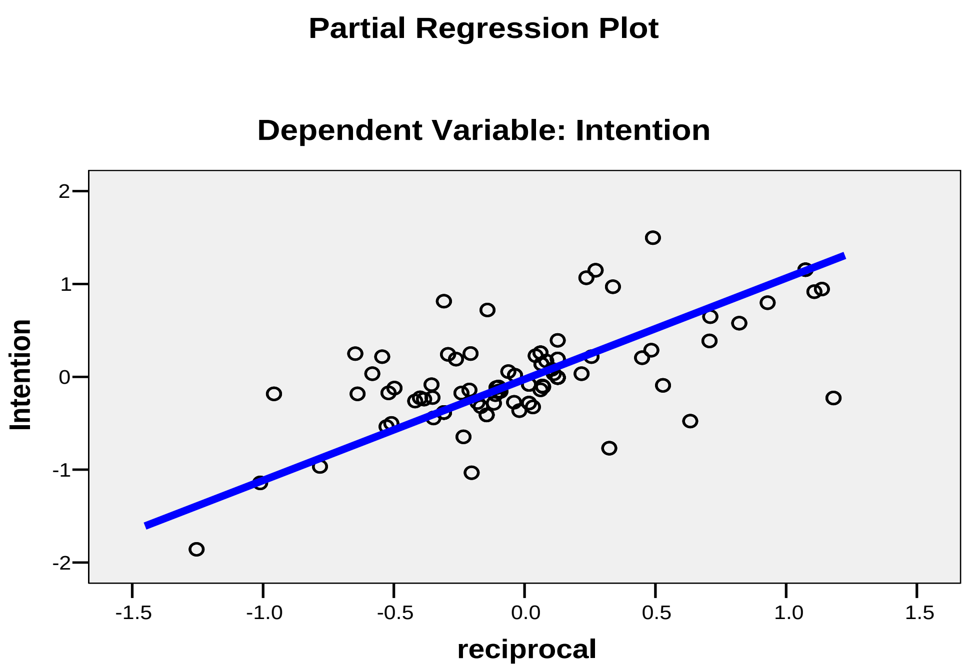
The second assumption is that the error term must be normally distributed. This can be assessed by looking at the normal P-P plot. The idea is that the points should be as close as possible to the diagonal line. If they are then we can assume that the error terms are normally distributed.

Normal P-P Plot of Regression Standardized Residual



3. Linearity

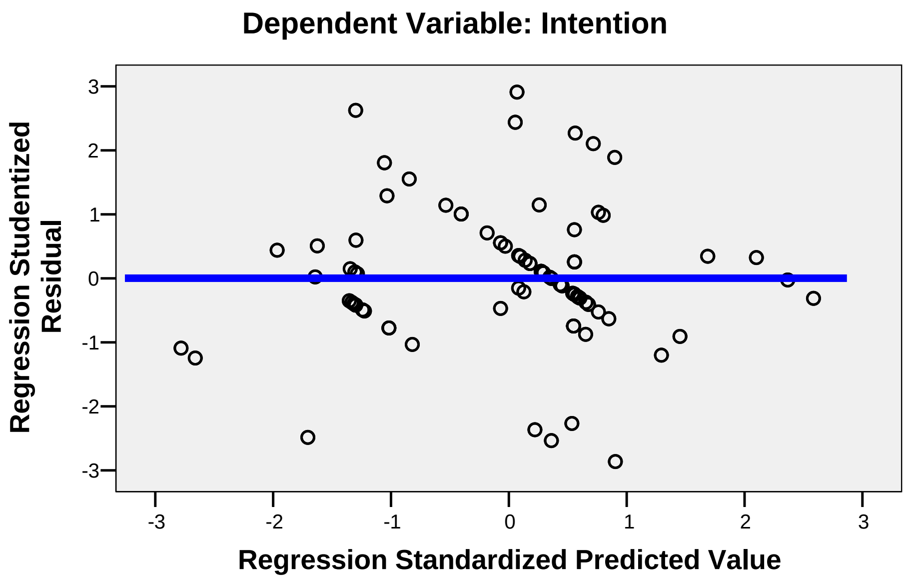
The third assumption is the relationship between the independent variables and the dependent variable must be linear. This is assessed by looking at the partial plots. The idea is to see if we can draw a straight line on the scatter plot that is generated.



4. Constant Variance – Homoscedasticity

The fourth assumption is that the variance must be constant (*Homoscedasticity*) as opposed to not constant (*Heterosedasciticity*). Heterosedasciticity is generally observed when we see a consistent pattern when we plot the studentized residual (**SRESID**) against the predicted value of Y (**ZPRED**).

Scatterplot



5. Multicollinearity

The fifth assumption is the collinearity problem. This is a problem when the independent variables are highly correlated among one another, generally at r > 0.8 to 0.9 which is termed as multicollinearoty. As the term independent variables connotes they should not be correlated at all among one another, low to moderate correlations are the norm and does not pose any serious problems. To assess this assumption we will look at two indicators. The first one is the VIF and tolerance. A low tolerance value of < 0.1 will result in a VIF value of > 10 as VIF is actually 1/Tolerance. If the value is more than 10 we can suspect there is a problem of multicollinearity. The second value that we should look at is the conditional index. If this value exceeds 30 we can also suspect the presence of multicollinearity. When the value is more than 30 we should also look across the variance proportions and see if we can spot any 2 or more variables with a value of 0.9 and above excluding the constant. If there are 2 or more than only we can conclude there is multicollinearity.

Collinearity Statistics	
Tolerance	VIF
.953	1.050
.644	1.553
.673	1.487
.967	1.034
.875	1.143

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions					
				(Constant)	reward	reciprocal	selfworth	ec	climate
1	1	5.830	1.000	.00	.00	.00	.00	.00	.00
	2	.093	7.917	.00	.88	.01	.00	.00	.05
	3	.039	12.267	.00	.10	.02	.13	.01	.61
	4	.022	16.232	.04	.01	.21	.10	.24	.04
	5	.011	22.754	.00	.00	.77	.71	.03	.15
	6	.005	35.280	.96	.00	.00	.06	.72	.15

a. Dependent Variable: Intention

6. Independence of the error term - Autocorrelation

This is an assumption that is particularly a problem with time series data and not for cross sectional data. We assume that each predicted value is independent, which means that the predicted value is not related to any other prediction; that is, they are not sequenced by any variable such as time. This can be assessed by looking at the Durbin Watson value. If the D-W value is between 1.5 – 2.5 then we can assume there is no problem.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.788[a]	.621	.611	.39849	1.597

a. Predictors: (Constant), climate, selfworth, ec, reward, reciprocal

b. Dependent Variable: Intention

Formula:

$$D = \frac{\sum_{i=2}^{n}(r_i - r_{i-1})^2}{\sum_{i=1}^{n} r_i^2}$$

Durbin-Watson Statistic, D

- $0 \leq D \leq 4$
- $D \approx 2$ - No autocorrelation
- $D < 1.5$ - 1st order + ve autocorrelation
- $D > 2.5$ - 1st order - ve autocorrelation

7. Outliers

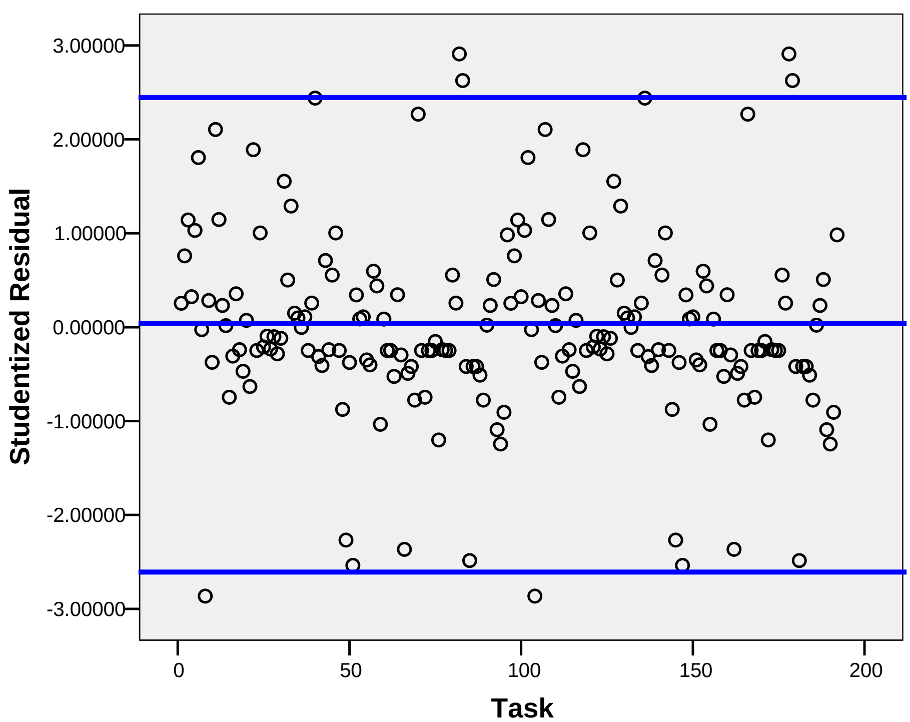
These are values which are extremely large and influential that they can influence the results of the regression. Usually the threshold is set at ± 3 standard deviations. Although this is the default some researchers may set a threshold of ± 2.5 to get better predictive power. This assumption can be easily identified by looking at whether there are casewise diagnostics.

Casewise Diagnostics[a]

Case Number	Std. Residual	Intention	Predicted Value	Residual
8	-2.695	3.20	4.2741	-1.07411
51	-2.511	3.00	4.0006	-1.00056
82	2.877	5.00	3.8535	1.14650
83	2.598	4.20	3.1648	1.03516
104	-2.695	3.20	4.2741	-1.07411
147	-2.511	3.00	4.0006	-1.00056
178	2.877	5.00	3.8535	1.14650
179	2.598	4.20	3.1648	1.03516

a. Dependent Variable: Intention

We need to deselect the cases identified and re-run the regression analysis to see the impact to the predictive power after taking out these outliers. If the impact is very minimal then we can conclude that these outliers are not influential.



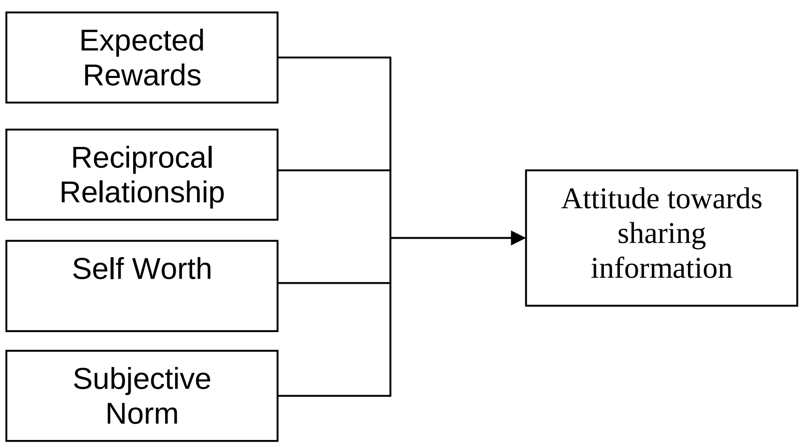
Advanced Diagnostics

There are several other measures that can be looked at to ascertain influential observations among them the more popular values looked at are Mahanalobis Distance, Cooks value and Leverage values.

MAH_1	COO_1	LEV_1
2.03888	0.00017	0.01067
1.00953	0.00102	0.00529
2.73682	0.00433	0.01433
14.17702	0.00151	0.07423
10.29052	0.01112	0.05388
2.71573	0.01077	0.01422
7.52153	0.00001	0.03938
20.87358	0.17681	0.10929
2.85149	0.00027	0.01493

Exercise 1

Test the model that has been shown below using a multiple regression. Ensure all the assumptions are met before proceeding with the interpretation. Summarize the output into a table and explain briefly the goodness of the model and also which of the variables impact the attitude towards sharing information.



Hierarchical Regression

Hierarchical multiple regression is used to determine what proportion of the variance in a particular variable is explained by other variables when these variables are entered into the regression analysis in a certain order and whether these proportions are significantly greater than would be expected by chance (Cramer, 2003).

There are at least 2 situations where the hierarchical regression can be used:

- **Control variable** regression
- **Moderating variable** regression

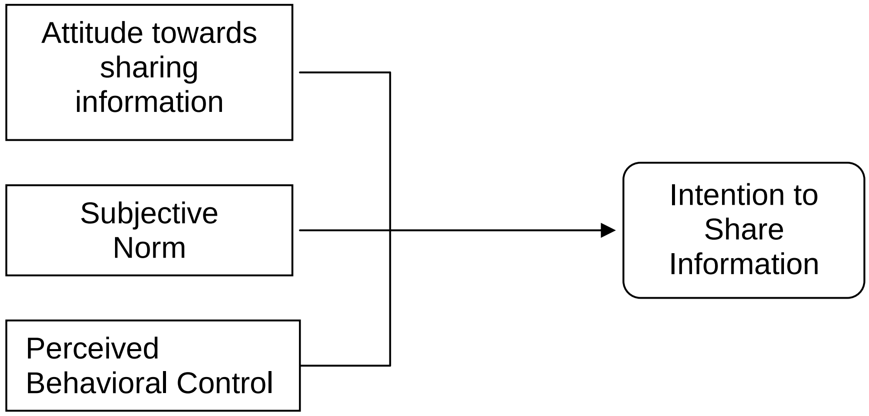
What is a control variable?

A control variable is a variable that may impact the dependent variable of interest but we are not particularly interested in studying their impact on the dependent variable. If we do not include them in the regression analysis we can run into a problem of over estimation of the predictive power in our regression.

For example when we would like to model the impact of job satisfaction on organizational commitment, many past researchers have found that demographic variables significantly impacts organizational commitment. Let's say we are no longer interested in these impact but we would like to isolate the impact of the demographic variables before we test the model variable which is job satisfaction. What we can do is to block the process of entering the variables into the equation in a two step hierarchical regression. We would enter the demographic variables in the first step and then the job satisfaction variable in the second step. In this analysis we would determine how much of the variation in organizational commitment is explained by the demographic variables in the first step and then the additional variance explained by job satisfaction in the second step will be attributed to job satisfaction variable alone. For this the value of R^2 change and the F change significance will be needed.

Exercise 2:

Test the model given below incorporating **gender** and **age** as control variables. Summarize the data into a table and briefly explain what you understand.



MODERATOR

Hierarchical multiple regression is used to determine what proportion of the variance in a particular variable is explained by other variables when these variables are entered into the regression analysis in a certain order and whether these proportions are significantly greater than would be expected by chance (Cramer, 2003). Hierarchical multiple regression has been advocated as a more appropriate method for determining whether a quantitative variable has a moderating effect on the relationship between two other quantitative variables (Baron and Kenny, 1986). A moderator specifies the conditions under which a given effect occurs, as well as the conditions under which the direction or strength of an effect vary. Baron and Kenny (1986, pp. 1174, 1178) describe a moderator variable as the following:

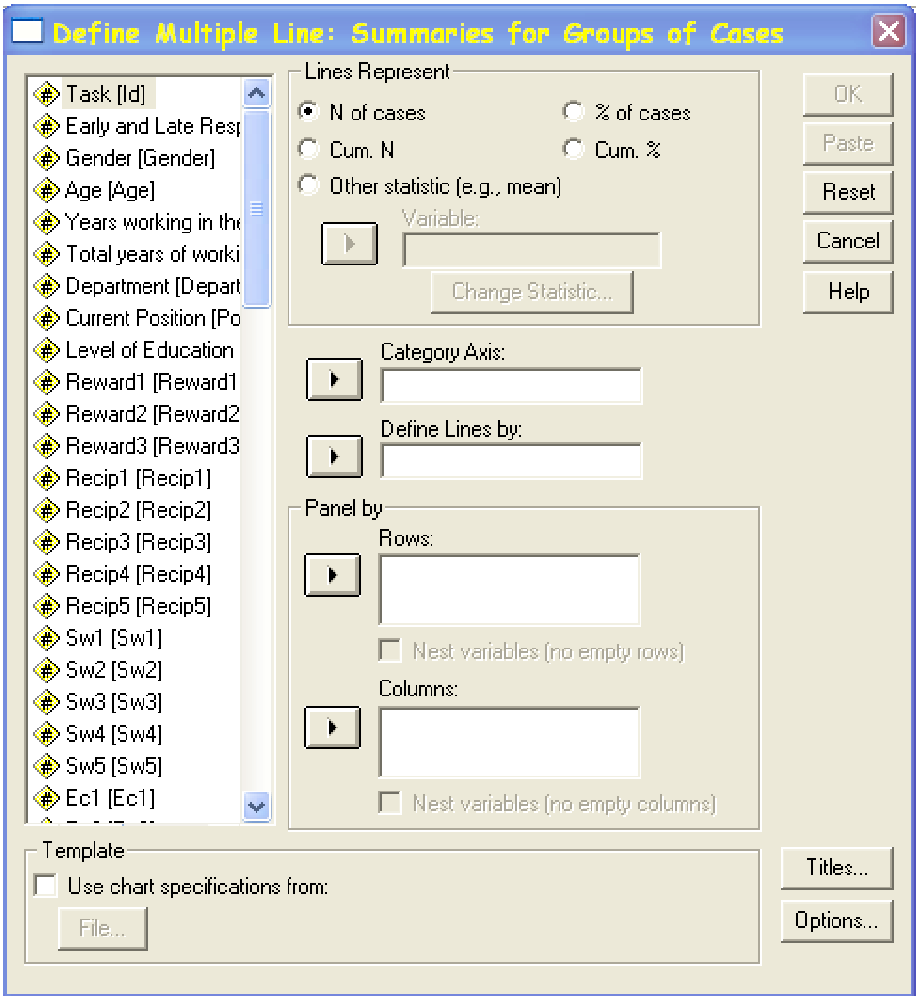
> *A qualitative (e.g., sex, race, class) or quantitative variable . . . that affects the direction and/or strength of a relation between an independent or predictor variable and a dependent or criterion variable . . . a basic moderator effect can be presented as an interaction between a focal independent variable and a factor (the moderator) that specifies the appropriate conditions for its operation . . .Moderator variables are typically introduced when there is an unexpectedly weak or inconsistent relation between a predictor and a criterion variable.*

A moderator variable is one that affects the relationship between two variables, so that the nature of the impact of the predictor on the criterion varies according to the level or value of the moderator. (Holmbeck, 1997) A moderator interacts with the predictor variable in such a way as to have an impact on the level of the dependent variable.

For testing purpose, a 3 step hierarchical regression will be conducted. In the first step the direct effect of the independent variables will be gauged, in the second step the moderator variable will be entered to gauge whether the moderator has a significant direct impact on the dependent variable and in the third step the interaction terms (the product of the independent variable and the moderator variable) will be entered to see the additional variance explained. For moderator effect to be present the **Step 3** must show significant R^2 increase with a significant F-change value.

Once Step 3 shows a significant R^2 increase then we can conclude that there is moderation effect. A word of caution here is that we cannot interpret the beta values in the third step as there is bound to be problems of multicollinearity. As such we have to resort to plotting line graphs to see the moderation effect.

Under **Graph**, choose **Line** and then **Multiple Line** and you will see the dialog box as shown below.



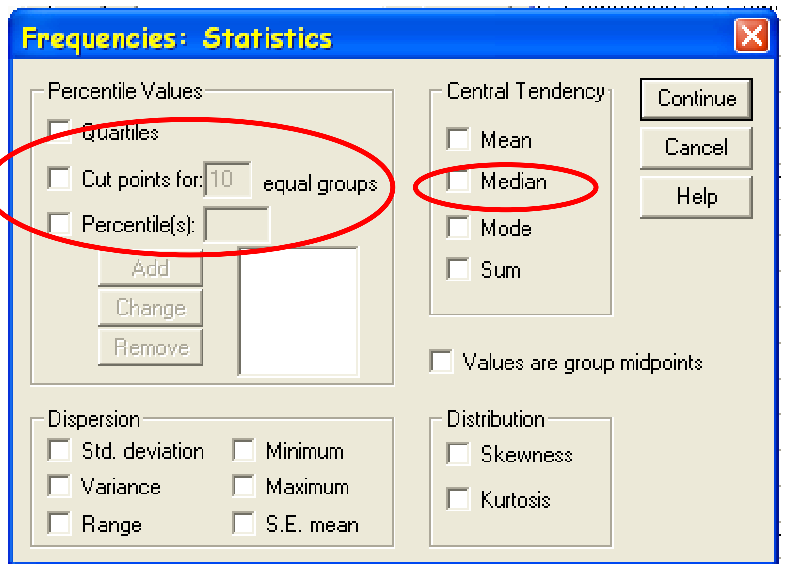
Click the button "Other statistic" and click in the **dependent variable**, as for the category axis click in the **independent variable** whereas the define lines by, click in the **moderator variable**.

The only problem would be when the independent variable is continuous and the moderator is also continuous then the plot cannot be done. First we have to break them into categories with **3 categories** or **2 categories**. For the moderator variable it is also advisable to use only 2 levels.

For the independent variables we can break them into 2 or 3 levels depending on situation. The standard values that can be used to re-categorize them into the levels are based on:

- 2 levels use **median**
- 3 levels use **percentile** (33 and 67%)

So first you have to ask fro frequencies of the relevant variables and under the option you can see the dialog box below:

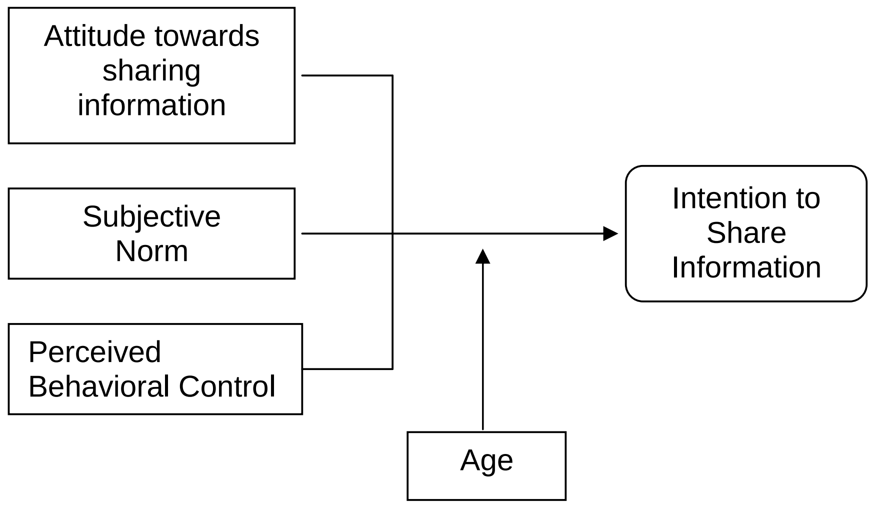


Once you have the median value or the percentile values then we have to use the function **Recode into a different variable**, for the median split, any value lowest thru the median value will be assigned the code 1= Low and values above the median will be assigned value 2= High.

For the percentile we will get 2 values, one value for the **33rd** percentile and another value for the **67th** percentile. Then we will also use the same function above but this time we will have 1= Low, 2= Moderate and 3= High.

Exercise 3:

Test the model given below to see if age moderates the relationship between attitude, subjective norm, perceived behavioral control and intention to share information. Summarize the relevant values into a table and conclude.



MEDIATOR

A mediator specifies how (or the mechanism by which) a given effect occurs (Baron & Kenny, 1986; James & Brett, 1984). Baron and Kenny (1986, pp. 1173, 1178) describe a moderator variable as the following:

> *The generative mechanism through which the focal independent variable is able to influence the dependent variable of interest . . . (and) Mediation . . . is best done in the case of a strong relation between the predictor and criterion variable.*

Shadish and Sweeney (1991) stated that "the independent variable causes the mediator which then causes the outcome". Also critical is the prerequisite that there be a significant association between the independent variable and the dependent variable before testing for a mediated effect.

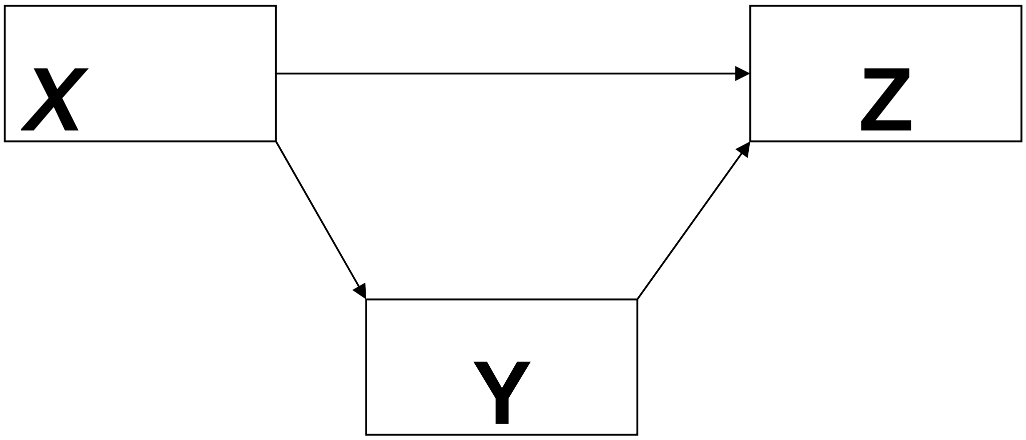
According to McKinnon et al, (1995), mediation is generally present when:

1. the IV significantly affects the mediator,
2. the IV significantly affects the DV in the absence of the mediator,
3. the mediator has a significant unique effect on the DV, and
4. the effect of the IV on the DV shrinks upon the addition of the mediator to the model.

Baron & Kenny (1986) has formulated the steps and conditions to ascertain whether full or partial mediating effects are present in a model. A graphical summary is presented in appendix 1.

Appendix 1: Testing Mediating Effect

Diagram drawn based on the original article by Baron and Kenny (1986). Illustrations are courtesy of Ramayah, T. and Jantan, M. from the School of Management, Universiti Sains Malaysia, 11800 Minden, Penang, Malaysia. Please e-mail: ramayah@usm.my or mjantan@usm.my for any clarifications.



Z = Dependent variable
X = Independent variable
Y = Intervening variable

Steps in testing:

Z	=	f(X)	=	a + bX
Y	=	f(X)	=	c + dX
Z	=	f(Y)	=	e + fY
Z	=	f(X,Y)	=	g + hX + jY

Full Mediator Effect:

- $b \neq 0$
- $d \neq 0$
- $f \neq 0$ also $j \neq 0$
- $h = 0$

Partial Mediator Effect:

- $b \neq 0$
- $d \neq 0$
- $f \neq 0$ also $j \neq 0$
- $h \neq 0$ but $h < b$

Ramayah, T., Ignatius, J. and Aafaqi, B. (2005). PC Usage among Students in a Private Institution of Higher Learning: The Moderating Role of Prior Experience, *Educators and Education Journal*, 20, 131-152.

References

Baron, R. M. and Kenny, D. A. (1986). The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic and Statistical Considerations. *Journal of Personality and Social Psychology.* 51(6), 1173-1182.

Cramer, D. (2003). *Advanced Quantitative Data Analysis*. Open University Press: Maidenhead, Philadelphia.

Holmbeck, G. N. (1997). Toward Terminological, Conceptual, and Statistical Clarity in the Study of Mediators and Moderators: Examples From the Child-Clinical and Pediatric Psychology Literatures, *Journal of Consulting and Clinical Psychology*, 95(4), 599-610.

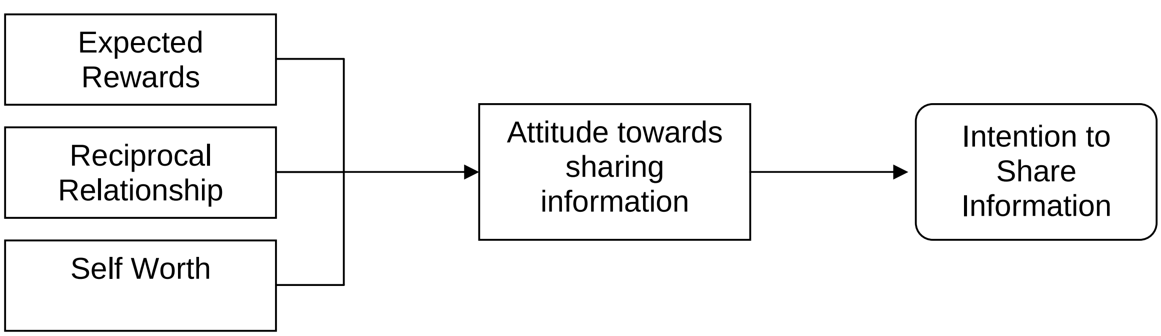
James, L. R. and Brett, J. M. (1984). Mediators, moderators, and tests for mediation, *Journal of Applied Psychology*, 69, 307-321.

McKinnon, D. P., Warsi, G., and Dwyer, J. H. (1995), A simulation study of mediated effect measures. Multivariate Behavioral Research, 30(1), 41-62.

Shadish, W. R. and Sweeney, R. B. (1991). Mediators and moderators in meta analysis: There's a reason we don't let dodo birds tell us which psychotherapies should have prizes, *Journal of Consulting and Clinical Psychology*, 59, 883-893.

Exercise 4:

The model below posits that the relationship between expected rewards, reciprocal relationship, self worth and intention to share information will be mediated by the attitude towards sharing information. Use the Baron and Kenny (1986) 4 step procedure to determine whether there is mediation or not.



Discriminant Analysis

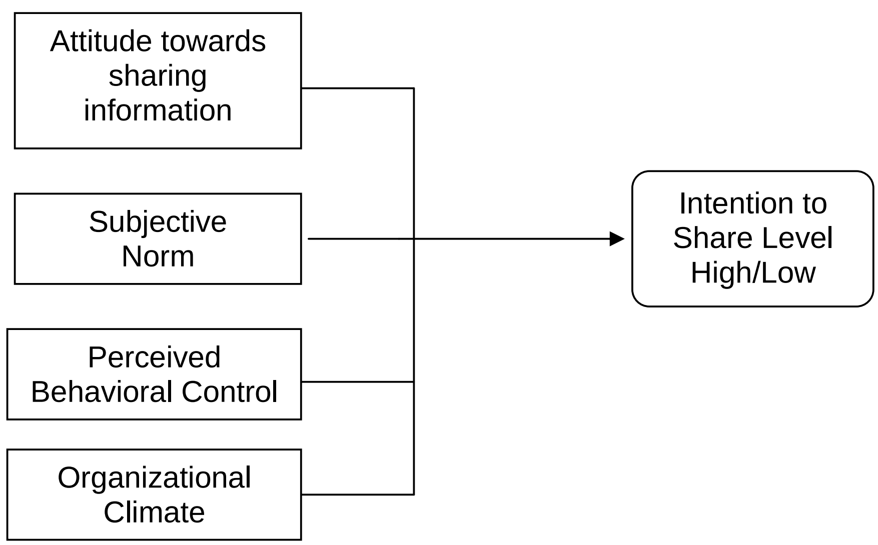
Discriminant, or discriminant function, analysis is a parametric technique to determine which weightings of quantitative variables or predictors best discriminate between 2 or more than 2 groups of cases and do so better than chance (Cramer, 2003). The analysis crates a discriminant function which is a linear combination of the weightings and scores on these variables. The maximum number of functions is either the number of predictors or the number of groups minus one, whichever of these two values is the smaller.

$$Z_{jk} = a + W_1X_{1k} + W_2X_{2k} + ... + W_nX_{nk}$$

Where:	Z_{jk}	=	discriminant Z score of discriminant function *j* for object *k*
	a	=	intercept
	W_i	=	discriminant coefficient for the independent variable *i*
	X_j	=	independent variable *i* for object *k*

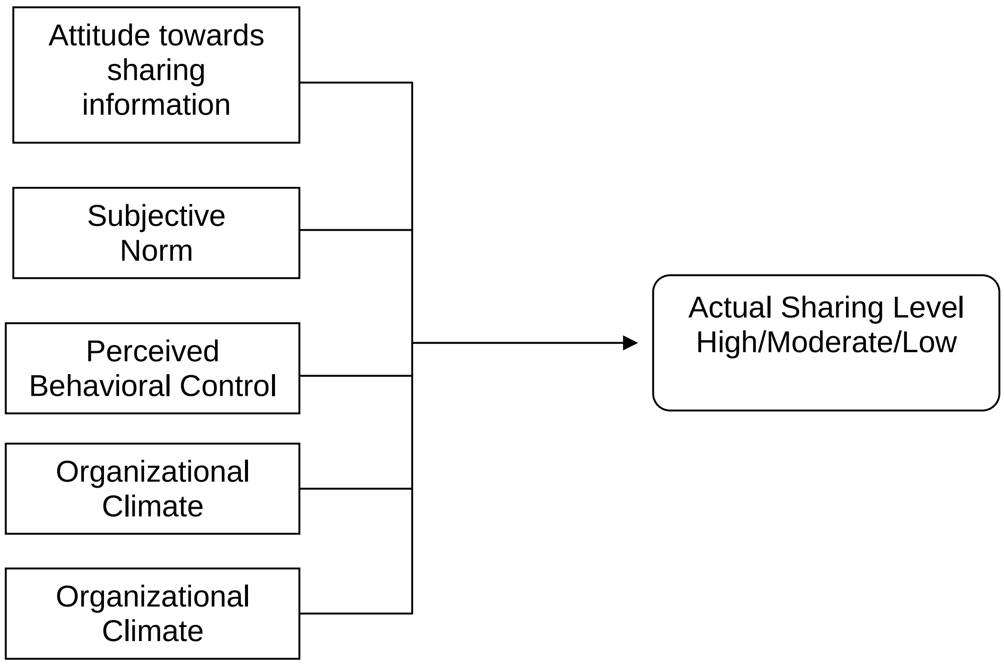
Exercise 5:

Using the model below develop a discriminant model and test the predictive validity of the model developed.



Exercise 6:

Using the model below develop a discriminant model and test the predictive validity of the model developed.



A GUIDE TO PRESENTING TABLES IN A RESEARCH REPORT

Prepared by:
T. Ramayah
School of Management
Universiti Sains Malaysia

1. Frequency Table

Table 1
Profile of respondents

Variable	Frequency	%
Gender		
Male	71	25.8
Female	204	74.2
Race		
Malay	38	13.8
Indian	8	2.9
Chinese	223	81.1
Others	6	2.2
Living Arrangement		
On Campus	107	38.9
Outside Campus	168	61.1
CGPA		
Below 2.00	1	0.4
2.00 – 2.33	20	7.3
2.34 – 2.67	59	21.5
2.68 – 3.00	97	35.3
3.01 – 3.33	81	29.5
3.34 – 3.67	11	4.0
Above 3.67	6	2.2

2. Factor Analysis

A factor analysis with varimax rotation was done to validate whether the respondents perceived the three constructs to be distinct. The results showed a three factor solution with eigenvalues greater than 1.0 and the total variance explained was 62.07% of the total variance. KMO measure of sampling adequacy was 0.887 indicating sufficient intercorrelations while the Bartlett's Test of Sphericity was significant (Chi square=3143.58, p< 0.01). The criteria used by Igbaria et al., 1995 to identify and interpret factors were: each item should load 0.50 or greater on one factor and 0.35 or lower on the other factor. Table 1 shows that result of the factor analysis. These results confirm that each of these constructs is unidimensional and factorially distinct and that all items used to measure a particular construct loaded on a single factor.

Table 2
Results of the factor Analysis

	Component		
	1	2	3
I find the PC useful in my job.	**0.910**	0.114	-0.056
Using the PC enables me to accomplish tasks more quickly.	**0.940**	0.150	-0.022
Using the PC increases my productivity.	**0.918**	0.173	-0.018
If I use the PC, I will increase my chances of getting a raise.	**0.859**	0.045	-0.170
My interaction with the PC is clear and understandable.	0.214	**0.837**	0.040
It is easy for me to become skillful at using the PC.	-0.010	**0.795**	-0.077
I find the PC easy to use.	0.103	**0.867**	-0.103
Learning to operate the PC was easy for me.	0.172	**0.831**	-0.174
Fun/Frustrating	-0.060	-0.046	**0.749**
Pleasant/Unpleasant	-0.021	-0.029	**0.689**
Pleasurable/Painful	-0.065	-0.006	**0.763**
Exciting/Dull	0.044	-0.085	**0.676**
Enjoyable/Unenjoyable	-0.178	-0.153	**0.710**
Eigenvalue	3.42	2.88	2.66
Percentage Variance (68.90)	26.31	22.13	20.46

Table 2
Results of the factor Analysis ***(Another way of presenting)***

Construct	Operational variable (item in the questionnaire)	Factor Loading	Cronbach's α	Composite reliability	AVE
Perceived Usefulness (PU)	I find the PC useful in my job.	**0.910**	0.894	0.757	0.711
	Using the PC enables me to accomplish tasks more quickly.	**0.940**			
	Using the PC increases my productivity.	**0.918**			
	If I use the PC, I will increase my chances of getting a raise.	**0.859**			
Perceived Ease of Use (PEU)	My interaction with the PC is clear and understandable.	**0.837**	0.951	0.952	0.798
	It is easy for me to become skillful at using the PC.	**0.795**			
	I find the PC easy to use.	**0.867**			
	Learning to operate the PC was easy for me.	**0.831**			
Perceived Enjoyment (PEJ)	Fun/Frustrating	**0.749**	0.751	0.906	0.510
	Pleasant/Unpleasant	**0.689**			
	Pleasurable/Painful	**0.763**			
	Exciting/Dull	**0.676**			
	Enjoyable/Unenjoyable	**0.710**			

3. Reliability Analysis results

Table 3
Reliability coefficients for the major variables

Variable	Number of items	Items dropped	Cronbach Alpha
Need for achievement	4	-	0.88
Locus of control	3	-	0.87
Self efficacy	2	-	0.86
Instrumental readiness	3	-	0.85
Subjective norms	3	-	0.86
Entrepreneurial intention	3	1	0.87

4. Descriptive Analysis

Table 4
Descriptive for the major variables

Variable	Mean	Standard Deviation
Attitude	4.68	1.10
Subjective norm	3.87	0.95
Perceived Usefulness	5.12	0.76
Perceived Ease of Use	4.92	1.33
Intention	4.23	1.25

Note: All items used a 7-point Likert scale with (1=Strongly disagree and 7=Strongly agree)

5. Chi Square Analysis

Table 5

Percentage Distribution of Complainers and Non-Complainers

Variable		% Complainers	% Non-Complainers	n	χ^2
Gender	Male	40.3	59.7	67	5.80**
	Female	20.0	80.0	55	
Marital Status	Single	18.2	81.8	33	3.55*
	Married	36.0	64.0	89	
Ethnicity	Malay	30.8	69.2	52	1.21
	Chinese	30.0	70.0	40	
	Indian	35.7	64.3	28	
	Others	0.0	100.0	2	
Age group (years)	15 – 24	23.1	76.9	13	2.54
	25 – 29	20.8	79.2	24	
	30 – 34	37.8	62.2	45	
	≥ 35	32.5	67.5	40	
Educational Level	SRP	0.0	100.0	1	12.32***
	SPM/STPM	4.5	95.5	22	
	Cert/Diploma	25.8	74.5	31	
	≥ Degree	42.6	57.4	68	
Job Category	White Collar	17.8	82.2	45	5.94**
	Blue Collar	39.0	61.0	77	

Note: *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$

6. T-test

Table 6

Differences in the major variables by gender

Variables	Male (Mean)	Female (Mean)	t-value
Need for achievement	5.21	5.14	1.19
Locus of control	4.60	4.68	-1.46
Self efficacy	4.43	4.17	3.27**
Instrumental readiness	4.23	3.96	3.78**
Subjective norms	4.22	4.12	2.92**
Entrepreneurial intention	4.48	3.98	3.92**

*p<0.05, **p<0.01

7. One Way ANOVA

Table 7

Differences in the major variables by ethnicity

	Malay (Mean)	Chinese (Mean)	Indian (Mean)	Others (Mean)
Need for achievement	5.30[a]	5.10[a]	4.91[b]	5.36[a]
Locus of control	4.65[a]	4.70[a]	4.35[b]	4.51[a]
Self efficacy	4.31[a]	4.20[a]	4.40[a]	4.49[a]
Instrumental readiness	4.14[a]	3.96[a]	4.27[a]	4.20[a]
Subjective norms	4.10[a]	4.00[b]	4.27[a]	4.48[a]
Entrepreneurial intention	4.22[a]	4.25[a]	4.31[a]	4.43[a]

Means with the same superscripts are not significantly different; means with different superscripts are significantly different at $p < 0.05$.

8. Correlation Analysis

Table 8

Intercorrelations of the major variables

	NAC	Locus	SE	Instrumental	SN
NAC	1.000				
Locus	0.357**	1.000			
SE	0.409**	0.204**	1.000		
Instrumental	0.418**	0.141**	0.670**	1.000	
SN	0.362**	0.048	0.477**	0.559**	1.000
Intention	0.365**	0.105**	0.511**	0.635**	0.567**

*$p<0.05$, ** $p<0.01$

9. Regression analysis direct

Table 9

Results of regression analysis

	Dependent variable Usage
Independent variables	
Perceived usefulness	0.423**
Perceived ease of use	0.371**
F value	128.07
R^2	0.490
Adjusted R^2	0.486

* $p<0.05$, ** $p < 0.01$

10. Regression Analysis with Control Variables

Table 10
Result of regression analysis

Variable	Frequency	
	Step 1	Step 2
Control variables		
Age	0.118	0.082
Gender (Male=1, Female=0)	0.472**	0.230**
Education	0.659**	0.626**
Model variables		
Perceived usefulness		0.503**
Perceived ease of use		0.215**
F value	36.79**	49.74**
R2	0.616	0.892
Adjusted R2	0.586	0.762
R2 change	0.616	0.276
F change	36.79**	12.95**

* $p<0.05$, ** $p < 0.01$

11. Hierarchical regression Analysis with Moderator

Table 11
Hierarchical Regression Results Using Viscidity as a Moderator in the Relationship between Power Bases and Influence in Group Buying Decisions

Independent Variable	Std Beta Step 1	Std Beta Step 2	Std Beta Step 3
Model Variables			
Reward	0.219*	0.218*	0.486
Coercive	0.210	0.175	-1.073
Legitimate	0.223*	0.230*	1.20*
Referent	-0.156	-0.168	-0.01*
Expert	0.289**	0.306**	-0.020
Information	-0.189	-0.196	0.296
Moderating Variable			
Viscidity		0.095	0.701*
Interaction Terms			
Viscidity*Reward			-0.458
Viscidity*Coercive			1.954**
Viscidity*Legitimate			-1.552*
Viscidity*Referent			-0.214
Viscidity*Expert			0.359
Viscidity*Information			-0.698
R2	0.350	0.358	0.486
Adj R2	0.301	0.300	0.393

R2 Change	0.350	0.008	0.128
Sig. F Change	0.000	0.334	0.012
Durbin Watson	1.938	1.938	1.938

*p < 0.05, **p < 0.01

When the interaction is significant then a graph is needed to explain the moderating effect as shown below. (Only for the Viscidity*Coercive interaction)

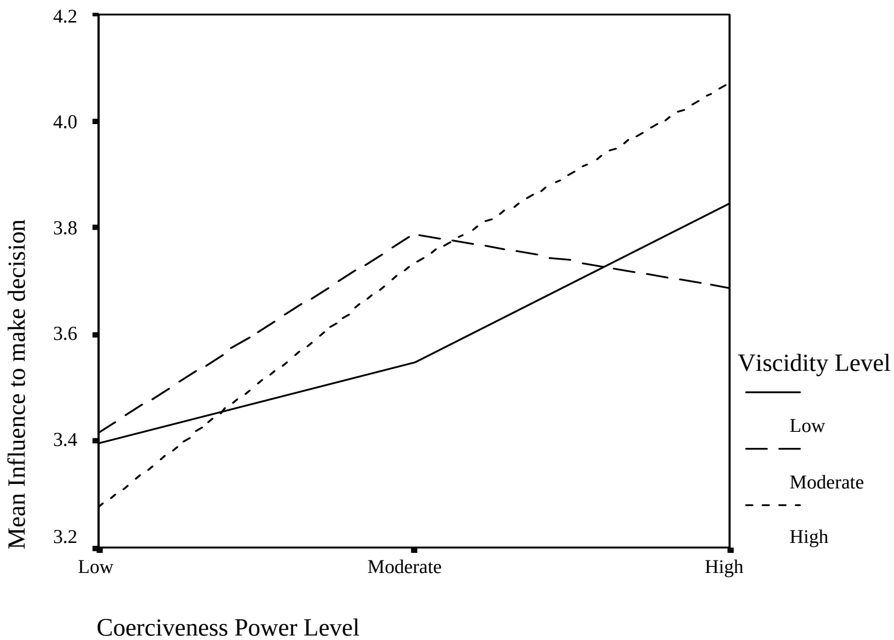
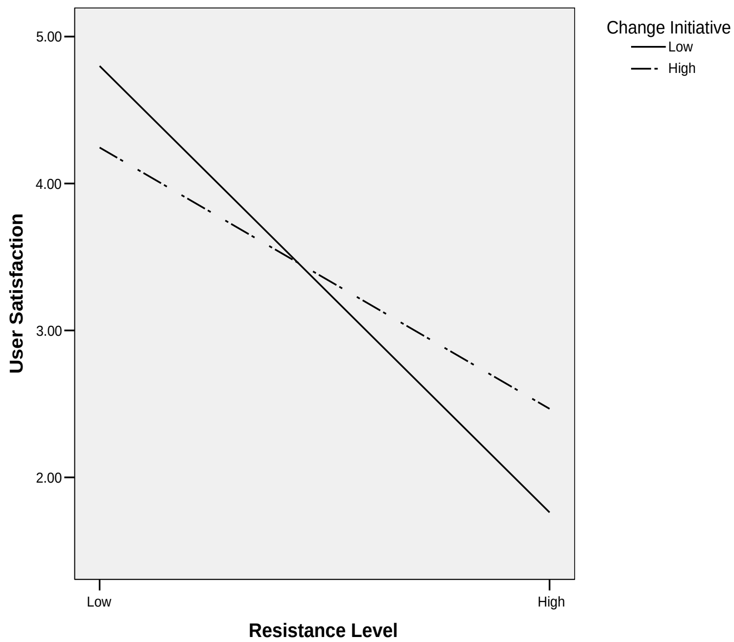


Figure 1. Moderating Effect of Viscidity on the Relationship between Coercive Power and Influence in Group Buying Decisions

Or a two level graph can be drawn



12. Mediated Regression Analysis

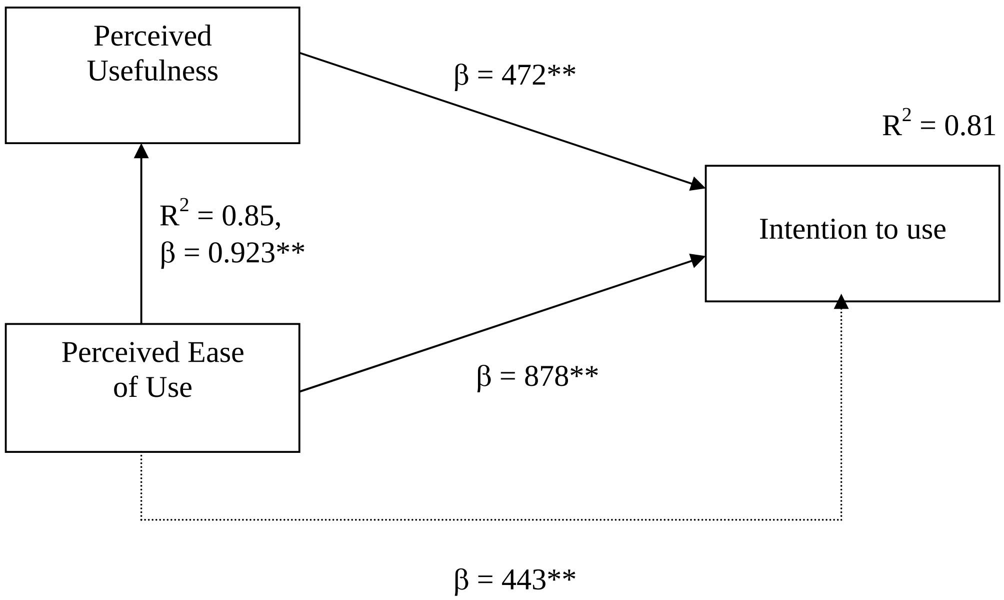


Figure 1. Mediating effect of perceived usefulness

13. Non-parametric Test for k-related samples

Table 13
Friedman Two-Way ANOVA Result

Friedman Two-Way ANOVA

Mean Rank	Variable
1.56	PAY Importance
3.01	COWORK Importance
3.26	PROMOTION Importance
3.37	SUPERVISION Importance
3.80	WORK Importance

Cases	Chi-Square	D.F.	Significance
112	130.5143	4	.0000

14. Paired t-test

Table 14
Paired t-test Result

Paired T-Test Between Perception and Importance of	Mean Paired Difference	Standard Deviation	t value
Pay	0.5521	0.628	10.55**
Promotion	-0.3442	0.686	-6.23**
Supervision	0.1115	0.480	2.88**
Work	-0.2678	0.430	-7.69**
Co-workers	0.1499	0.544	3.33**

* $p < 0.05$, ** $p < 0.01$

15. Discriminant Analysis

Table 1
Hit Ratio for Cases Selected in the Analysis

Actual Group	Category	No. of Cases	Predicted Group Membership	
			Accept	Did not accept VSS
Accept VSS	1	91	78 *85.7*	13 *14.3*
Did not accept VSS	2	63	15 *23.8*	48 *76.2*

Percentage of "grouped" cases correctly classified: 81.8%

Table 2
Hit Ratio For Cross Validation (Leave One Out Classification)*

Actual Group	No. of Cases	Predicted Group Membership	
		Accept	Did not accept VSS
Accept VSS	91	74 *81.3*	17 *18.7*
Did not accept VSS	63	17 *27.0*	46 *73.0*

Percentage of "grouped" cases correctly classified: 77.9%

* In cross validation, each case is classified by the functions derived from all cases other than that case. Numbers in italics indicate the row percentages

Table 3
Hit Ratio for Cases in the Holdout Sample

Actual Group	No. of Cases	Predicted Group Membership	
		Accept	Did not accept VSS
Accept VSS	40	35 *87.5*	5 *12.5*
Did not accept VSS	30	3 *10.0*	27 *90.0*

Percentage of "grouped" cases correctly classified: 88.6%. Numbers in italics indicate the row percentages

Table 4
Comparison of Goodness of Results

Measure	Value	Hit Ratio for Holdout Sample
Maximum Chance Proportional Chance	58.5% 51.6%	88.6% 88.6%
Comparison with Hair et al. (1998) 1.25 times higher than chance	73.12%	
Press Q Table Value Calculated Value	6.635 58.51**	

*** p< 0.01*

As shown above, the predictive accuracy of the model for the analysis sample was 81.8%, the cross validation sample was 77.9% and the holdout sample was 88.6% respectively. The values in Table 4 indicate that the hit ratio of 88.6% exceeded both the maximum and proportional chance values. The hit ratio also exceeded the chance criteria by more than 25% (Hair et al., 1998) thus providing support for the predictive accuracy of the model. The Press Q statistics of 58.51, was significant. Hence, the model investigated has good predictive power. With a canonical correlation of 0.611, it can be concluded that 37.3% (square of the canonical correlation) of the variance in the dependent variable was accounted for by this model. A summary of the univariate analysis indicating the influential variables to the acceptance/non-acceptance decision is presented in Table 5.

Table 5
Summary of Interpretive Measures for Discriminant Analysis

Independent Variable	Discriminant Loading (rank)	Discriminant Function	Univariate F Ratio
Close friends	0.687	0.649	42.751**
Spouse	0.506	0.608	23.180**
Health Needs	0.497	0.396	22.344**
VSS Counselor	0.396	0.401	14.198**
Co-workers	0.395	-0.396	14.124**
Security Needs	0.388	0.308	13.610**
Current/Ex-Boss	0.335	-0.328	10.171**
VSS Consultant	0.253	-0.108	5.799*
Management	0.225	0.045	4.595*
Self-Esteem Needs	0.209	-0.010	3.941*
Self-Actualization Needs	0.157	0.183	2.226
Social Needs	0.101	-0.328	0.920

Group Centroid for Acceptors	0.638
Group Centroid for Non Acceptors	-0.922
Wilks Lambda	0.627**
Canonical squared correlation	0.611

*p< 0.05, **p< 0.01

16. List of Variables and Measurement with sample questions

Table 15

Sample questions from the questionnaire

Variable	Sample Question	Source
Perceived ease of use	It was easy for me to become skillful at using the course website.	Selim (2003) α = 0.912
Perceived usefulness	Using the course website improves the quality of the course work I do.	Selim (2003) α = 0.910
Usage	I use the course website whenever possible to do my course work.	Selim (2003) α = 0.909