ASSIGNMENT

Course Code	**:**	**MS - 95**
Course Title	**:**	**Research Methodology for Management Decisions**
Assignment Code	**:**	**MS-95/TMA/SEM - II /2012**
Coverage	**:**	**All Blocks**

Note: Answer all the questions and send them to the Coordinator of the Study Centre you are attached with.

1. **Explain the meaning of "Analysis of Variance". Describe briefly the techniques of analysis of variance for two-way classifications.**

2. **Define and classify secondary data. Also discuss the process of evaluating the secondary data.**

3. **What is the meaning of measurement in research? What difference does it make if we measure in terms of a nominal, ordinal, interval or ratio scale?**

4. **The customers arriving at the booking counter of a Road traffic Corporation sex-wise are expected to follow a random sequence. The position in respect of 30 passengers on a day was as follows:**

   M M F F F M F F M M F F F F M M M F F M M F M M M F F F M M

   Comment whether the arrival pattern is random.

5. **Write shot notes on**

   a) **Components of a Research Problem.**

   b) **Thurstone Scale**

   c) **Multivariate Analysis**

==

1.Explain the meaning of “Analysis of Variance”. Describe briefly the techniques of analysis of variance for two-way classifications.

Analysis of Variance .

A statistical technique which helps in making inference whether three or more samples might come from populations having the same mean; specifically, whether the differences among the samples might be caused by chance variation

It is a collection of statistical models, and their associated procedures, in which the observed variance

is partitioned into components due to different explanatory variables.

EXAMPLE

-take a sample of 5000 people, who never drank red wine for 10 years.

-take another sample of 5000 people who drank red wine 2 glasses everyday over the 10 years.

CHECK THE MEAN LIFE SPAN OF THE TWO GROUPS.

THE SECOND GROUP MEAN LIFE SPAN WAS 78 YEARS,

AS AGAINST THE FIRST GROUP, WHOSE MEAN LIFE SPAN WAS ONLY 64 YEARS.

==

Analysis of Covariance (ANCOVA):

Analysis of covariance is a more sophisticated method of analysis of variance. It is based on inclusion of supplementary variables (covariates) into the model. This lets you account for inter-group variation associated not with the "treatment" itself, but with covariate(s).
Suppose you analyze the results of a clinical trial of three types of treatment of a disease - "Placebo", "Drug 1", and "Drug 2". The results are three sets of survival times, corresponding to patients from the three treatment groups. The question of interest is whether there is a difference between the three types of treatment in the average survival time.
You might use analysis of variance to answer this question. But, if you have supplementary information, for example, each patient's age, then analysis of covariance allows you to adjust the treatment effect (survival time, in this case) to a particular age, say, the mean age of all patients. Age in this case is a "covariate" - it is not related to treatment, but can affect the survival time. This adjustment allows you to reduce the observed variation between the three groups caused not by the treatment itself but by variation of age.
If the covariate(s) are associated with the treatment effect, then analysis of covariance may have more power than analysis of variance.

===

COVARIANCE

The main purpose af the analysis of covariance is statistical control of variability when experimental control can not be used. It is a statistical method for reducing experimental error or for removing the effect of an extraneous variable. Statistical control is obtained by using a concomitant variable (called the covariate) along with the dependent variable. The analysis of covariance makes use of linear prediction or regression as described in chapter one under "Linear Prediction." The underlying rational for the analysis of covariance is the idea of using prediction equations to predict the values (scores and means) of the dependent variable on the basis of the values of the covariate variable, and then subtracting these predicted scores and means from the corresponding values of the dependent variable. Oversimplifying a bit, the analysis of covariance is like an analysis of variance on the residuals of the values of the dependent variable, after removing the influence of the covariate, rather than on the original values themselves. In so far as the measures of the covariate are taken in advance of the experiment and they correlate with the measures of the dependent variable they can be used to reduce experimental error (the size of the error term) or control for an extraneous variable by removing the effects of the covariate from the dependent variable.

The two-way analysis of variance is an extension to the one-way analysis of variance. There are two independent variables (hence the name two-way).

Assumptions

- The populations from which the samples were obtained must be normally or approximately normally distributed.
- The samples must be independent.
- The variances of the populations must be equal.
- The groups must have the same sample size.

Hypotheses

There are three sets of hypothesis with the two-way ANOVA.

The null hypotheses for each of the sets are given below.

The population means of the first factor are equal. This is like the one-way ANOVA for the row factor.

The population means of the second factor are equal. This is like the one-way ANOVA for the column factor.

There is no interaction between the two factors. This is similar to performing a test for independence with contingency tables.

Factors

The two independent variables in a two-way ANOVA are called factors. The idea is that there are two variables, factors, which affect the dependent variable. Each factor will have two or more levels within it, and the degrees of freedom for each factor is one less than the number of levels.

Treatment Groups

Treatement Groups are formed by making all possible combinations of the two factors. For example, if the first factor has 3 levels and the second factor has 2 levels, then there will be 3x2=6 different treatment groups.

As an example, let's assume we're producing a pharma product. The type of chem. A and type of chem. B are the two factors we're considering in this example. This example has 15 treatment groups. There are 3-1=2 degrees of freedom for the type of CHEM A, and 5-1=4 degrees of freedom for the type of CHEM B. There are 2*4 = 8 degrees of freedom for the interaction between the type of CHEM A and type of CHEM B.

The data that actually appears in the table are samples. In this case, 2 samples from each treatment group were taken.

	Chem. b I	Chem. b II	Chem. b III	Chem. b IV	Chem. b V
Chem.b A-402	106, 110	95, 100	94, 107	103, 104	100, 102
Chem.b B-894	110, 112	98, 99	100, 101	108, 112	105, 107

Chem. b C-952	94, 97	86, 87	98, 99	99, 101	94, 98

Main Effect

The main effect involves the independent variables one at a time. The interaction is ignored for this part. Just the rows or just the columns are used, not mixed. This is the part which is similar to the one-way analysis of variance. Each of the variances calculated to analyze the main effects are like the between variances

Interaction Effect

The interaction effect is the effect that one factor has on the other factor. The degrees of freedom here is the product of the two degrees of freedom for each factor.

Within Variation

The Within variation is the sum of squares within each treatment group. You have one less than the sample size (remember all treatment groups must have the same sample size for a two-way ANOVA) for each treatment group. The total number of treatment groups is the product of the number of levels for each factor. The within variance is the within variation divided by its degrees of freedom.

The within group is also called the error.

F-Tests

There is an F-test for each of the hypotheses, and the F-test is the mean square for each main effect and the interaction effect divided by the within variance. The numerator degrees of freedom come from each effect, and the denominator degrees of freedom is the degrees of freedom for the within variance in each case.

Two-Way ANOVA Table

It is assumed that main effect A has a levels (and A = a-1 df), main effect B has b levels (and B = b-1 df), n is the sample size of each treatment, and N = abn is the total sample size. Notice the overall degrees of freedom is once again one less than the total sample size.

Source	**SS**	**Df**	**MS**	**F**
Main Effect A	*Given*	A, a-1	SS / df	MS(A) / MS(W)
Main Effect B	*Given*	B, b-1	SS / df	MS(B) / MS(W)
Interaction Effect	*Given*	A*B, (a-1)(b-1)	SS / df	MS(A*B) / MS(W)
Within	*Given*	N - ab, ab(n-1)	SS / df	
Total	sum of others	N - 1, abn - 1		

Summary

The following results are calculated using the Quattro Pro spreadsheet. It provides the p-value and the critical values are for alpha = 0.05.

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F-crit*
CHEM A	512.8667	2	256.4333	28.283	0.000008	3.682
CHEM B	449.4667	4	112.3667	12.393	0.000119	3.056
Interaction	143.1333	8	17.8917	1.973	0.122090	2.641
Within	136.0000	15	9.0667			
Total	**1241.4667**	**29**				

From the above results, we can see that the main effects are both significant, but the interaction between them isn't. That is, the types of chem. a aren't all equal, and the types of chem. b aren't all equal, but the type of seed doesn't interact with the type of chem. b.

##

2.Define and classify secondary data. Also discuss the process of evaluating the secondary data.

Secondary

These are sources containing data that have been collected and compiled for another purpose. The secondary sources consist of readily available compendia and already compiled statistical statements and reports whose data may be used by researches for their studies, e.g., census reports, annual reports and financial statements of companies, Statistical statements, Reports of Government Departments, Annual Reports on currency and finance published by the National Bank for Ethiopia, Statistical Statements relating to Cooperatives, Federal Cooperative Commission, Commercial Banks and Micro Finance Credit Institutions published by the National Bank for Ethiopia, Reports of the National Sample Survey Organisation, Reports of trade associations, publications of international organisations such as UNO, IMF, World Bank, ILO, WHO, etc., Trade and Financial Journals, newspapers, etc.

Secondary sources consist of not only published records and reports, but also unpublished records. The latter category includes various records and registers maintained by firms and organisations, e.g., accounting and financial records, personnel records, register of members, minutes of meetings, inventory records, etc.

Features of Secondary Sources: Though secondary sources are diverse and consist of all sorts of materials, they have certain common characteristics.

First, they are readymade and readily available, and do not require the trouble of constructing tools and administering them.

Second, they consist of data over which a researcher has no original control over collection and classification. Others shape both the form and the content of secondary sources. Clearly, this is a feature, which can limit the research value of secondary sources.

Finally, secondary sources are not limited in time and space. That is, the researcher using them need not have been present when and where they were gathered.

Secondary data is the data that have been already collected by and readily available from other sources. Such data are cheaper and more quickly obtainable than the primary data and also may be available when primary data can not be obtained at all.

Advantages of Secondary data

1. It is economical. It saves efforts and expenses.
2. It is time saving.
3. It helps to make primary data collection more specific since with the help of secondary data, we are able to make out what are the gaps and deficiencies and what additional information needs to be collected.
4. It helps to improve the understanding of the problem.
5. It provides a basis for comparison for the data that is collected by the researcher.

Disadvantages of Secondary Data

1. Secondary data is something that seldom fits in the framework of the marketing research factors. Reasons for its non-fitting are:-
    a. Unit of secondary data collection-Suppose you want information on disposable income, but the data is available on gross income. The information may not be same as we require.
    b. Class Boundaries may be different when units are same.

Before 5 Years	**After 5 Years**
2500-5000	5000-6000
5001-7500	6001-7000
7500-10000	7001-10000

    c. Thus the data collected earlier is of no use to you.
2. Accuracy of secondary data is not known.
3. Data may be outdated.

Evaluation of Secondary Data

Because of the above mentioned disadvantages of secondary data, we will lead to evaluation of secondary data. Evaluation means the following four requirements must be satisfied:-

1. **Availability-** It has to be seen that the kind of data you want is available or not. If it is not available then you have to go for primary data.
2. **Relevance-** It should be meeting the requirements of the problem. For this we have two criterion:-
    a. Units of measurement should be the same.
    b. Concepts used must be same and currency of data should not be outdated.
3. **Accuracy-** In order to find how accurate the data is, the following points must be considered: -
    a. Specification and methodology used;
    b. Margin of error should be examined;
    c. The dependability of the source must be seen.

4. **Sufficiency-** Adequate data should be available.

Robert W Joselyn has classified the above discussion into eight steps. These eight steps are sub classified into three categories. He has given a detailed procedure for evaluating secondary data.

1. Applicability of research objective.
2. Cost of acquisition.
3. Accuracy of data.

##

3.What is the meaning of measurement in research? What difference does it make if we measure in terms of a nominal, ordinal, interval or ratio scale?

Measurement is the process observing and recording the observations that are collected as part of a research effort. There are two major issues that will be considered here.

First, you have to understand the **fundamental ideas** involved in measuring. Here we consider two of major measurement concepts. In **Levels of Measurement**, I explain the meaning of the four major levels of measurement: nominal, ordinal, interval and ratio. Then we move on to the **reliability** of measurement, including consideration of true score theory and a variety of reliability estimators.

Second, you have to understand the different **types of measures** that you might use in social research. We consider four broad categories of measurements. **Survey research** includes the design and implementation of interviews and questionnaires. **Scaling** involves consideration of the major methods of developing and implementing a scale. **Qualitative research** provides an overview of the broad range of non-numerical measurement approaches. And **unobtrusive measures** presents a variety of measurement methods that don't intrude on or interfere with the context of the research

There are different **levels of measurement** that have been classified into four categories. It is important for the researcher to understand the different levels of measurement, as these levels of measurement play a part in determining the arithmetic and the statistical operations that are carried out on the data.

In ascending order of precision, the four different levels of measurement are nominal, ordinal, interval, and ratio.

The first level of measurement is **nominal measurement**. In this level of measurement, the numbers are used to classify the data. Also, in this level of measurement, words and letters can be used. Suppose there are data about people belonging to two different genders. In this case, the person belonging to the female gender could be classified as F, and the person belonging to the male gender could be classified as M. This type of assigning classification is nothing but the nominal level of measurement.

The second level of measurement is the **ordinal level** of measurement. This level of measurement depicts some ordered relationship between the number of items. Suppose a student scores the maximum marks in the class. In this case, he would be assigned the first rank. Then, the person scoring the second highest marks would be assigned the second rank, and so on. This level of measurement signifies some specific reason behind the assignment. The ordinal level of measurement indicates an approximate ordering of the measurements. The researcher should note that in this type of measurement, the difference or the ratio between any two types of rankings is not the same along the scale.

The third level of measurement is the **interval level** of measurement. The interval level of measurement not only classifies and orders the measurements, but it also specifies that the distances between each interval on the scale are equivalent along the scale from low interval to high interval. For example, an interval level of measurement could be the measurement of anxiety in a student between the score of 10 and 11, if this interval is the same as that of a student who is in between the score of 40 and 41. A popular example of this level of measurement is temperature in centigrade, where, for example, the distance between 94^0C and 96^0C is the same as the distance between 100^0C and 102^0C.

The fourth level of measurement is the **ratio level** of measurement. In this level of measurement, the measurements can have a value of zero as well, which makes this type of measurement unlike the other types of measurement, although the properties are similar to that of the interval level of measurement. In the ratio level of measurement, the divisions between the points on the scale have an equivalent distance between them, and the rankings assigned to the items are according to their size.

The researcher should note that among these levels of measurement, the nominal level is simply used to classify data, whereas the levels of measurement described by the interval level and the ratio level are much more exact.

1. Measure the cycle time
2. Measure the Business value, ROI and not the number of items or hours worked. Who cares if fruit that you made isn't juicy.
3. Customer satisfaction – most will put their faith into customer survey – they allocate 1024 questions and forget to free the customer off. The ultimate question is much superior approach, you ask just one question. It goes like this: Would you offer this (product) to a friend? The scale would be from 1 to 10, 1 is recommending it to an enemy.

For a meaningful comparison, quality criteria for measurement properties are needed.

STUDY DESIGN AND SETTING: Quality criteria for content validity, internal consistency, criterion validity, construct validity, reproducibility, longitudinal validity, responsiveness, floor and ceiling effects, and interpretability were derived from existing guidelines and consensus within our research group.

RESULTS: For each measurement property a criterion was defined for a positive, negative, or indeterminate rating, depending on the design, methods, and outcomes of the validation study.

CONCLUSION: Our criteria make a substantial contribution toward defining explicit quality criteria for measurement questionnaires.

##

4.The customers arriving at the booking counter of a Road traffic Corporation sex-wise are expected to follow a random sequence. The position in respect of 30 passengers on a day was as follows:

M M F F F M F F M M F F F F M M M F F M M F M M M F F F M M

Comment whether the arrival pattern is random.

The concept of a **random sequence** is essential in probability theory and statistics. The concept generally relies on the notion of a sequence of random variables and many statistical discussions begin with the words "let $X_1,...,X_n$ be independent random variables...". Yet "A random sequence is a vague notion... in which each term is unpredictable to the uninitiated and whose digits pass a certain number of tests traditional with statisticians

What are the characteristics usually associated with randomness? A common idea is to identify randomness with *unpredictability*. This intuition originates in people's experience with games of chance. For example, a sequence of coin tosses looks very irregular, and no matter how many times we've tossed the coin, say a thousand times, no one seems to be able to predict the outcome of the next toss. That arguably explains the widespread use of randomizing devices, like coins, dice, and bones, to guarantee *fairness*in gambling3 and decision-making.

Consider the following outcomes:

•00000000000000000000000
•01101010000010011110011
•11011110011101011111011.

The first result is generally considered suspect, while the second and third "look" random. However, according to probability theory all three outcomes, and in fact all the 223 possible outcomes, have the same probability of 1⁄223. Why, then, do the last two outcomes*seem* random while the first does not?

It is conceivable that the ultimate reason for that perception "belongs to the domain of psychology" [**29**], to be found in the structure of our visual-cognitive apparatus. Such issues notwithstanding, the question is whether it is possible to distinguish random from nonrandom strings in a mathematically meaningful way. Note that our intuition cannot be trusted much in this task. It's enough to observe that the second string above consists of the first twenty-three digits of the binary expansion of
√
2 −1. So,
although it "looks" random, in the sense of exhibiting no obvious pattern, its digits were obtained by a process (root extraction) that, by all reasonable standards, is *not* random. Note the overall similarity with the third string, obtained by coin-tossing.

For strings it is only possible to develop a notion of *degrees of randomness*, there being no sharp demarcation of the set of all strings into random and nonrandom ones [**7**].

In fact, once a certain binary string with *m* zeroes is considered random, there is no reason not to consider equally random the string obtained by adding (or subtracting) one more zero to it (or from it).

The situation becomes clearer if one considers instead the set of all *infinite* binary strings, or *sequences of bits*. Although in real life applications we are bound to encounter only*finite*, albeit very long, strings, it is nevertheless worth considering this further idealization. The idea of taking infinite objects as approximations to finite but very large ones is not new. For example, in equilibrium statistical mechanics, in order to have a sharp notion of a phase transition one has to work in the so-called thermodynamic limit, in which the number of particles tends to infinity (as does the volume, but in such a way that particle density remains constant).5 The great advantage of working with sequences is that they are easier to handle mathematically. This curious and common state of affairs is probably a result of treating a completed infinity as one whole (though large) object, instead of having to keep track of a large (but finite) number of

objects (which makes combinatorics such a difficult craft). In particular, it is possible to obtain a *sharp* result, that is, to write $\{0, 1\}N = R \cup Rc$, decomposing the set of sequences into random and nonrandom ones.
But now the question becomes: What does it mean to say that an *individual* infinite sequence of 0s and 1s is random? Historically, three main notions were proposed6:
•*stochasticness*or *frequence stability*, due to von Mises, Wald, and Church;
•*incompressibility*or *chaoticness*, due to Solomonoff, Kolmogorov, and Chaitin;
•*typicality*, due to Martin-L¨of.
Interestingly, all these proposals ended up involving two notions apparently foreign to the subject of randomness: *algorithms computability*. With hindsight, this is not totally surprising. In a sense to be clarified as we proceed, randomness will be closely associated with "noncomputability."

BASED ON THE ABOVE LOGIC , THE ARRIVAL PATTERN IS RANDOM.

##

5.Write shot notes on

A]Components of a Research Problem.

Components of a Research Problem.

First, the defined properties or characteristics of a good problem statement varied from one source read to the next depending on the subject addressed. For example, one document related to computer science defined four properties of a good problem statement as complete, precise, consistent and general. Another document dealing with scientific research described a good problem statement as one that expresses a relationship between two or more variables is stated clearly and unambiguously as a question and that implies possibilities of empirical testing. Taking all these characteristics and summing what remained constant from one definition to the next I conclude that a good problem statement is simply one that clearly and concisely conveys the issues and concerns addressed.

Second, it became clear that coming up with a good problem statement is not as easy as most would think. Bridget N. O'Connor tells us in Information Technology, Learning and Performance Journal, Vol. 18, No. 2, Fall 2000 that a good problem statement is far from effortless." She defines it instead as a "complex activity related to preparing a logical argument".

I concluded based on the characteristics discussed above that in order for a problem statement to convey all issues and concerns in a clear and concise fashion it must have the following components:

The given constants and variables - this consists of all the information necessary to fully describe the situation.

The end goal - this is the desired end state of the problem.

Obstacles - assertions or steps through which the necessary information or other resources will be obtained or performed to achieve the desired end state of the problem

Twelve **Components** of **Research**:

1. Purpose/Goals/Questions

2. **Research** Philosophy

3. Conceptual/Theoretical Frame - Heart of study

4. **Research** Design/Model
5. Setting/Circumstances (Description of Setting)

6. Sampling Procedure

7. Background and Experience of Researcher

8. Role/s of Researcher
9. Data Collections Methods

10. Data Analysis/Interpretation

11. Applications/Recommendations

12. Presentation Format and Sequence

##################################

B]Thurstone Scale

Notion of Scaling

- **They are validated measuring instruments, instruments whose psychometric properties have been established.**

- **They are sets of symbols or numerals so constructed that the symbols or numerals can be assigned by rules to the individuals to whom the scale is applied.**

- **Uniformity of procedures when administering the test.**

Types of Standardized Scales

- **Summated Rating or Likert Scale**

- **Semantic Differential**

- **Guttman Scale (also called the Bogardus Social Distance Scale**
- **Thurstone Scale (also called Equal-appearing interval scale)**

Thurstone /Equal Appearing Interval Scale

- **It is designed to generate groups of indicators of a variable having an empirical structure among them.**
- **Judges may then be asked to estimate how strong an indicator of a variable each item is-by assigning scores.**

Advantages and disadvantages of scales

- **Efficiency-simple to use**
- **Inexpensive, readily available, generally take very little time or energy on the part of either practitioner or client.**
- **Easy to administer and score**

Disadvantages/Problems

- **Since they deal with predetermined questions and problems, they may not be exactly or completely suited to all the specific characteristics of the problem one is faced with.**
- **Tend to be broad-banded and tend not to be very direct measures of a problem**
- **Response set effect**
- **Acquiescence**
- **The assumption that we know which traits are important**

==

The Method of Equal-Appearing Intervals

Developing the Focus. The Method of Equal-Appearing Intervals starts like almost every other scaling method -- with a large set of statements. Oops! I did it again! You can't start with the set of statements -- you have to first define the focus for the scale you're trying to develop. Let this be a warning to all of you: methodologists like me often start our descriptions with the first objective methodological step (in this case, developing a set of statements) and forget to mention critical foundational issues like the development of the focus for a project. So, let's try this again...

The Method of Equal-Appearing Intervals starts like almost every other scaling method -- with the development of the focus for the scaling project. Because this is a unidimensional scaling method, we assume that the concept you are trying to scale is reasonably thought of as one-dimensional. The description of this concept should be as clear as possible so that the person(s) who are going to create the statements have a clear idea of what you are trying to measure. I like to state the focus for a scaling project in the form of a command -- the command you will give to the people who will create the statements. For instance, you might start with the focus command:

The Other Thurstone Methods

The other Thurstone scaling methods are similar to the Method of Equal-Appearing Intervals. All of them begin by focusing on a concept that is assumed to be unidimensional and involve generating a large set of potential scale items. All of them result in a scale consisting of relatively few items which the respondent rates on Agree/Disagree basis. The major differences are in how the data from the judges is collected. For instance, the method of paired comparisons requires each judge to make a judgement about each pair of statements. With lots of statements, this can become very time consuming indeed. With 57 statements in the original set, there are 1,596 unique pairs of statements that would have to be compared! Clearly, the paired comparison method would be too time consuming when there are lots of statements initially.

@@@@@@@@@@@@@@@@@@@@@@@@@@@

C] multivariate Analysis

Multivariate analysis (MVA) is based on the statistical principle of multivariate statistics, which involves observation and analysis of more than one statistical variable at a time. In design and analysis, the technique is used to perform trade studies across multiple dimensions while taking into account the effects of all variables on the responses of interest.

Uses for multivariate analysis include:

- Design for capability (also known as capability-based design)
- Inverse design, where any variable can be treated as an independent variable
- Analysis of Alternatives (AoA), the selection of concepts to fulfill a customer need
- Analysis of concepts with respect to changing scenarios
- Identification of critical design drivers and correlations across hierarchical levels.

Multivariate analysis can be complicated by the desire to include physics-based analysis to calculate the effects of variables for a hierarchical "system-of-systems." Often, studies that wish to use multivariate analysis are stalled by the dimensionality of the problem. These concerns are often eased through the use of surrogate models, highly accurate approximations of the physics-based code. Since surrogate models take the form of an equation, they can be evaluated very quickly. This becomes an enabler for large-scale MVA studies: while a Monte Carlo simulation across the design space is difficult with physics-based codes, it becomes trivial when evaluating surrogate models, which often take the form of response surface equations.

Multivariate Data Analysis refers to any statistical technique used to analyze data that arises from more than one variable. This essentially models reality where each situation, product, or decision involves more than a single variable. The information age has resulted in masses of data in every field. Despite the quantum of data available, the ability to obtain a clear picture of what is going on and make intelligent decisions is a challenge. When available information is stored in database tables containing rows and columns, Multivariate Analysis can be used to process the information in a meaningful fashion.

Multivariate analysis methods typically used for:

- Consumer and market research
- Quality control and quality assurance across a range of industries such as food and beverage, paint, pharmaceuticals, chemicals, energy, telecommunications, etc
- Process optimization and process control
- Research and development

Tools for Multivariate Analysis

Among the various, multivariate tools available, The Unscrambler® stands out as an all-in-one multivariate data analysis software product. This product and related ones from CAMO are proven tools that have enabled different organizations solve their Multivariate Analysis requirements.

##