Profiling, a procedure for evaluating methodological adequacy, is a prerequisite for the acceptance or rejection of the conclusions of the investigation, is discussed. Three elements of this procedure are presented: (1) structuring of a logical argument, (2) generation of data, and (3) analysis of data. All three elements are employed in hypothesis testing, and the second two are employed for empirical studies. Three aspects of data generation: representativeness, treatment, and measurement, are presented graphically as dimensions for the research quality cube. Ordinal scales, to facilitate profiling, are given for each of the three dimensions. Problems of data analysis are noted and the development of grids for the profiling analysis procedure is explained. Flow charts for guiding the research profiling are appended. (LR)
PHI DELTA KAPPA
RESEARCH SERVICE CENTER

OCCASIONAL PAPER

92: PROFILING EDUCATIONAL RESEARCH

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ACKNOWLEDGEMENTS

The work described herein is based on the thoughts and efforts of many predecessors. Some of them are recognized in the paper presented by my colleague, Bruce B. Bartos. Through continued interactions James Raths, Robert Ingle, Robert Remstad, and Bruce Bartos have made valuable contributions to this paper. These gentlemen and the many others who have worked at evaluation of the adequacy of educational research deserve the major credit for any advancements this paper might make to our deliberations. Its inadequacies are the responsibility of its author.

W. J. G.
PROFILING COMPLETED RESEARCH

The evaluation of the quality of completed research in education has two distinct components. The first of these components is the problem attacked in the study. The second is the methodological adequacy of the study conducted. Profiling, the procedure described in this paper, deals with the latter, the evaluation of the methodological adequacy. It avoids evaluation of the problem itself on the belief that the importance of a given problem can only be established through a historical perspective. To assert otherwise would imply the existence of a preferred value system.

Evaluation of methodological adequacy of a given piece of research is a prerequisite for the acceptance or rejection of the conclusions of that investigation. Such conclusions can be no stronger than the methods utilized in generating and analyzing the data on which the conclusions are reached. In the past we have operated on the assumption; if the methodology is sound, the conclusion can be accepted and vice versa. The faultiness of this assumption is one of the problems that have long plagued both the improvement of and use of educational research.

Research methodology is multifaceted. It involves an inherent logical argument, the selection of subjects to be studied, structuring of experiences for those subjects, measurement, and the analysis of the generated data. It is possible to have sound procedures in some of these facets and weak procedures in others; a possibility that precludes a statement that a conclusion is based either on sound or unsound methods.

The problem is further complicated. Needs for surety in varying times and professional circumstances set the quality standard for research methods. If the need for knowledge in an area is great, the methodological development crude, and the
amount of risk to personal safety low, conclusions can be accepted and operated on despite weaknesses in their methodological base. In another set of circumstances this would be wholly unacceptable. Since the use to which a conclusion might be put cannot be controlled, an absolute level of quality cannot be established for each research effort.

Regardless of the knowledge needs or professional circumstances, a given conclusion ought not to be accepted, held tentatively or rejected without evaluation of the research methods underlying it. It is asserted that the profiling procedure described in this paper will facilitate the labeling of the methodology of completed research reports. When this labeling has been completed, the user of that study can make sounder decisions regarding the acceptance or rejection of its conclusions.

ELEMENTS IN PROFILING

In conducting an empirical study an investigator does numerous things. Those things are the elements on which the profiling activity focuses. They include: (1) the structuring of a logical argument; (2) the generation of data; and (3) the analysis of that data. All three items are involved in investigations which test hypotheses while only items two and three are used in studies which attempt to answer empirical questions.

THE INHERENT LOGICAL ARGUMENT is of crucial importance when a study attempts a test of a hypothesis. In effect, the investigator is trying to determine the truth or falsity of his hypothesis. He does this through a logical argument described by Polya. It consists of a major premise, one or more minor premises, and a conclusion.

The major premise is typically a statement which asserts, “If the ______ hypothesis is a true statement; then ______ events will be observed as indicators of that truth.” An example of a major premise can be seen in a study reported a few years ago by McNeil. He proposes a hypothesis which asserts
that teachers present different instructional treatments for the two sexes of their students. As indicators of the truth of that statement he reasoned that boys would be nominated more often than girls as recipients of certain kinds of teacher action. His major premise could be stated as,

If the hypothesis (teachers provide different instructional treatment for boys than they do for girls) is a true statement, then systematic differences by sex will be seen when children are asked to name the students who receive specified teacher treatments.

Two kinds of minor premises have been evolved from Polya's work by Raths. The first of these deals with the predicted observation. Was it or was it not seen? The premise's exact nature in a given study is determined after the data are analyzed. In the McNeil example used above, significant differences by sex were observed. The minor premise in that case would be, "There is a systematic sex differentiation in the nominations."

The second category of minor premises deals with rival hypotheses, rival or alternative explanations for the observation reported in the first minor premise. The premise is based upon the recognition that an effect in the social sciences often has multiple causes. Once an observation has been made, all its possible causes must be examined before it can be concluded that the observation supports the truth of a specific hypothesis. One of three general conditions might exist ranging from no rival hypotheses are apparent to rival hypotheses may exist to rival hypotheses are definitely involved.

The final element of the logical argument is the conclusion. Its form in a given study is dependent upon the nature of the two minor premises. From the first minor premise comes information as to whether or not the truth of the hypothesis being tested is supported. If the consequents predicted are observed, support for the truth of the hypothesis is presented. If the observation is not made, support cannot be claimed. (Note: Failure to make the predicted observation does not automatically mean rejection of
the hypothesis.) The second minor premise determines the strength of the conclusion. If rival hypotheses are known to be present very weak support for the truth of the hypothesis has been developed. If there is the possibility but not the probability of rival hypotheses, tentative support is generated. And finally, if no rival hypotheses are conceivable, it is credible that the hypothesis is a true statement.

THE GENERATION OF DATA, the second major facet in profiling, involves evaluation of three aspects of data generation: units studied; treatments experienced by those units; and measurement. If variation in any of these three occurs a different set of data is generated. For example, consider an investigation of the effects of test anxiety on achievement. If the study concentrates on a randomly selected group of high school seniors as subjects, one set of data will be generated. If a group of students who are divergent on a measure of test anxiety is selected as subjects, a different set of data will be generated. Given a specified group as subjects, variation in the treatment or of their experiences will cause different sets of data to be generated. Again the test anxiety problem provides an example. One set of data could be generated by a treatment in which the subjects are given information about the importance of a test and administered a test that is constructed for students at a much higher level of education than are the subjects. Still a different set of data will be generated if the students are repeatedly given a test that is very difficult. If the effects of a specific treatment on a specific group are measured by a paper and pencil test such as Sarason’s Test of Test Anxiety, one set of data would be generated. On the other hand if the seats in the classroom were wired and a galvanic skin response measure were taken, quite a different set of data would be generated.

These three aspects of data generation are displayed graphically in Figure 1. The scale of unit quality or representativeness runs along the dimension OA, treatment quality OC, and measurement quality OG. A project which selected a sample perfectly representative of a population of interest would be located at Point A. on the cube. If, in that same study, a
thorough programing of the content and sequence of the treatments was employed in generating data, the project would be conceptualized as being at Point B. on the quality cube. Finally, if our study employed perfectly objective, valid, and reliable measuring techniques, it would be located at Point E. on the cube.

A given study seldom reaches this level of data generation quality. Rather it falls somewhere between the extremes. To facilitate profiling ordinal scales have been developed for these three dimensions as shown below.

Dimensions for the Research Quality Cube

Representativeness

R5 = The entire population was studied
R4 = Random selection from a specified population was employed to determine which units were studied.
R3 = Purposive sampling from a specified population established the group studied.
R2 = Volunteers were studied.
R1 = An unidentified group of subjects was studied.

Treatment

T6 = A theoretically based treatment was administered and described and controls were employed for mediating variables identified in the theory AND for variables extraneous to the theory that might have an effect.
T5 = Same as T6 with the exception of the lack of controls for extraneous variables.
T4 = Same as T6 with the exception of the lack of controls for theory encompassed mediating variables and extraneous variables.
T3 = No theory stated but the employed treatment described in detail sufficient for replication.
T2 = Commonly known treatment administered but not
Entire population or perfect sample

Maximumly valid, reliable, and objective instrument

Totally controlled content & sequence
described in detail.

$T_1 = $ Something of an undescribed nature was experienced by the units studied.

Measurement

$M_5 = $ Data were generated through the use of either a commercially standardized or ad hoc instrument AND data are presented which establish high validity and reliability for its use in this measurement task.

$M_4 = $ Data generated through the use of a commercially standardized instrument and evidence presented indicating moderate validity and reliability for this application.

$M_3 = $ Data generated through a commercially standardized test but no evidence presented as to its validity and reliability for this application.

$M_2 = $ Data generated through an ad hoc instrument and evidence of moderate validity and reliability presented.

$M_1 = $ Data generated through an ad hoc instrument with either no supporting evidence as to validity and reliability or evidence indicating poor validity and reliability on either a commercially standardized or ad hoc instrument.

DATA ANALYSIS PROCEDURES are the final element in profiling. When data, typically in the form of numbers, are generated as the supporting evidence for a conclusion, understanding of the meaning of those numbers is incumbent upon the researcher and the research utilizer. That meaning is not readily apparent if there is a large quantity of numbers. Simplifying procedures have been developed; procedures which are not appropriate for all kinds of data.

The determination of the correct procedure in a given study is not an exact science. In developing a procedural flow chart for the profiling of educational research, sixteen schemes were identified which were supposed to assist in the selection of the correct statistic for given sets of data. Some of these were incomplete schemes in that they purported to deal only with
limited kinds of statistical analysis. Some imply a comprehensiveness but fail to be definitive as they list a number of statistics appropriate for a given set of conditions.

Since a single comprehensive grid or table for selecting the correct analytic procedure could not be found a second task was undertaken. Existing statistical procedures were catalogued and the assumptions underlying them were listed. An effort to build a comprehensive selection procedure by analyzing these items has to this point been unsuccessful. (A colleague at Indiana University has just recently attacked this problem using Guttman's Facet design and Analysis Technique with initially promising results.)

Because of these problems three grids have been generated for profiling the data analysis procedures. The first of these deals with analytic procedures for sample description. It includes measures of central tendency and dispersion and classifies the procedures by levels of measurement, i.e., nominal, ordinal, and interval-ratio. The second grid is used when an associational analysis is desired. It has identical labels for its rows and columns which refer to the nature of the measurement on the two variables to be correlated. The categories in this case are:

1. Continuous variables (age, height, I.Q., achievement, etc.)
2. Forced dichotomy (number of persons over and under 100 I.Q., number of persons weighing over and under 150 pounds, etc.)
3. True dichotomy (student-nonstudent, male-female, etc.)

Given the nature of the two variables on which an associational analysis is desired the grid can be used to select the appropriate statistic. Four special cases exist and are shown with the grid. Three of these are instances in which more than two variables are involved. The final case covers correlation among ordinal variables.

The third grid deals with inferential statistics, instances in which a generalization about the relationship between the
numbers generated by observation of some sample are indicative of observations that could be made on the entire population. The categorizing elements on this grid are the number of dependent and independent variables, the level of measurement, and the number of groups. Again the determination of the appropriate level on each category for a given set of data leads to the recommended statistic.

The use of these grids leads to a specific statistic (in the inference grid there is the possibility of alternatives). Through the article the analytic procedure actually used can be identified. Two quality categories follow from a comparison of the statistic used and the statistic appropriate for the data and purpose of the study: first, the statistic used is identical with the statistic identified and appropriate; second, they are different. In the former the research is profiled as appropriately analyzed; in the latter, as inappropriately analyzed.

PROFILING SUMMARIZED: When a study has been analyzed and profiled, it has been described on the following basis:

A. Is it (1) a test of a hypothesis, or (2) an answer to an empirical question?

A1. If it is a test of a hypothesis, is the strength of conclusion: I The hypothesis is very little more credible; II more credible; or III very much more credible?

B. What is the quality of the data generation procedure (tişûm)?

C. Is the data: (a) appropriately analyzed; or (b) inappropriately analyzed.

It should be noted that a single project may consist of several substudies, each of which may be profiled separately. A decisional flow chart has been developed for arriving at the profile for a given study. It is appended. Your reactions regarding its adequacy are welcomed.

It is believed that through profiling completed research their adequacies and inadequacies can be made apparent and can more
readily be considered as the conclusions of the research are weighed in decision situations. One further benefit is seen. Studies of such profiles should pinpoint problems that could keep research methodologists busy for years to come.
FOOTNOTES


APPENDIX

FLOW CHART FOR GUIDING THE RESEARCH PROFILING

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FACETS OF THE RESEARCH PROCESS

STRUCTURE OF A LOGICAL ARGUMENT

LOGIC

GENERATION OF DATA

DATA QUALITY-REPRESENTATIVENESS

DATA QUALITY-TREATMENT

DATA QUALITY-MEASUREMENT

STATISTICAL ANALYSIS OF DATA

DATA ANALYSIS

PROFILE

1 2 3 4 5
A REPORT FROM THE PROFESSIONAL LITERATURE

EXAMINE FOR PRESENTATION OF DATA

ARE DATA PRESENTED?
YES → 1

ARE HYPOTHESES EXAMINED? INCLUDES (1) 2 OR MORE VARIABLES (2) PREDICTED RELATIONSHIP

IDENTIFY & STATE HYPOTHESIS & CONSEQUENTS

ARE CONSEQUENTS LOGICAL IF THE HYPOTHESIS IS AN TRUE STATEMENT?

DOES NOT SAY 1

LOCATE SECTION THAT REPORTS ON THE OBSERVATION OF THE CONSEQUENTS

YES → 2

ARE RIVAL HYPOTHESES NOT IDENTIFIED POSSIBLY IN IT KNOWN TO BE PRESENT?

LABEL: H3

LABEL: H2

TRUTH OF HYPOTHESIS IS VERSIFIED

TRUTH OF HYPOTHESIS IS CREDIBLE

REQUEST HYPOTHESES

EXAMINE FOR RIVAL HYPOTHESES

ARE QUESTIONS ANSWERABLE BY DIRECT OBSERVATION?

YES → 3

ARE QUESTIONS BOTHPOSED AND ANSWERED

NO → 4

ARE QUESTIONS ANSWERED BY DIRECT OBSERVATION?

YES → 5

IS A LOGICAL REFERENT OBSERVED TO ANSWER THE "QUESTION?"

NO → 6

LABEL: Q

LABEL: H

EXAMINE FOR QUESTIONS POSED & ANSWERED

STOP: REPORT IS EITHER INCOMPLETE OR NOT RESEARCH

NO → 7

STOP: REPORT IS EITHER INCOMPLETE OR NOT RESEARCH
IMPLICITLY
HYPOTHESIS
1. IDENTIFY & STATE
HYPOTHESIS
2. CONSEQUENTS
PRESENTED?
EXAMINE FOR
QUESTIONS
FOSED & ANSWERED
ARE QUESTIONS
BOTH FOSED AND
ANSWERED?
ARE QUESTIONS
ANSWERABLE BY
DIRECT OBSERVA-
TION?
ARE A LOGICAL
REFERENT OBSERVED
TO ANSWER THE
QUESTION?
LABEL: Hs
STOP: ILOGICAL
RELATIONSHIPS
EXIST
ARE CONSEQUENTS
LOGICAL IF THE
HYPOTHESIS IS A
TRUE STATEMENT?
NO
YES
NO
EXAMINE FOR RIVAL
HYPOTHESES
ARE RIVAL
HYPOTHESES
NOT IDENTIFIABLE?
NOT IDENTIFIABLE
NOT IDENTIFIABLE
KNOWN
KNOWN TO BE
PRESENTED?
NO
Yes
Yes
No
LABEL: Hs
TRUTH OF
HYPOTHESIS IS
VERIFIED
LABEL: Hc
TRUTH OF
HYPOTHESIS IS
QUESTIONABLE
LABEL: Hs
TRUTH OF
HYPOTHESIS IS
CREDIBLE
LABEL: Hc
NO CONCLUSION
REGARDING THE
TRUTH OF THE
HYPOTHESIS
WERE THE CONSEQUENTS
OBSERVED?
YES
NO
LOCATE SECTION
THAT REPORTS ON
THE OBSERVATION
OF THE CONSEQUENTS.
LABEL: Hs
TRUTH OF
HYPOTHESIS IS
QUESTIONABLE
LABEL: Hc
TRUTH OF
HYPOTHESIS IS
CREDIBLE
RESEARCH PROFILING FLOW CHART
LOGIC
IDENTIFY:
1. POPULATION OF
INTEREST
2. SAMPLE STUDIED

DOES THE REPORT
DELELGATE THE
POPULATION TO
WHICH THE GEN-
ERALIZATIONS
APPLY?

IDENTIFY:
HOW THE UNITS
STUDIED WERE
SELECTED.

RESEARCH PROFILING FLOW CHART
DATA QUALITY - REPRESENTATIVENESS
RESEARCH PROFILING FLOW CHART
DATA QUALITY - TREATMENT

IDENTIFY:
1. TREATMENT
2. DEGREE OF SPECIFICITY OF PROCEDURE

HAS EACH STEP OF THE TREATMENT BEEN SPECIFIED

IDENTIFY:
1. THEORETICAL BASIS FOR TREATMENT
2. CONTROLS FOR MEDIATING VARIABLES
3. CONTROLS FOR EXTRANEOUS VARIANCES

DOES A THEORY IDENTIFY THE RELEVANT VARIABLES AND DETAIL THEIR INTER RELATIONSHIPS

THEORY WAS STATED AND MEDIATING VARIABLES WERE CONTROLLED

THEORY WAS STATED BUT MEDIATING VARIABLES WERE NOT CONTROLLED

TECHNIQUES USED TO DISTRICT MEDIATING VARIABLES

THREE VARIABLES WERE CONTROLLED

MACH STEPS

THE MAIN FEATURES OF THE TREATMENT ARE KNOWN

NO THEORY, BUT TREATMENT DESCRIBED IN DETAIL

NO THEORY, BUT MEDIATING VARIABLES WERE NOT CONTROLLED

THEORY WAS STATED, BUT MEDIATING VARIABLES WERE NOT CONTROLLED

STANDARDIZED RESEARCH PROCEDURE

WAS A STANDARDIZED PROCEDURE USED?

THE MAJOR DETAILS OF THE TREATMENT STATED OR SOMETHING UNDEFINED HAPPENED TO THE UNITS STUDIED

LABEL: T1
LABEL: T2
LABEL: T3
LABEL: T4
LABEL: T5

WELL TECHNIQUES WERE USED TO DISTRICT MEDIATING VARIABLES

YES

YES

YES

YES
IDENTIFY & LIST EACH MEASURING INSTRUMENT

2. (on reverse side Profile Sheet)

FOR EACH INSTRUMENT LISTED, ITERATE THROUGH THE COMPLETE CYCLE

LABEL: M1 INFORMATION AVAILABLE THAT THE INSTRUMENT IS VALID FOR THIS USE.

LABEL: M2 PROJECT DEVELOPED INSTRUMENT WITH LOW V, I, O OR OTHER INSTRUMENT WITH NO INFO ABOUT VALIDITY OR DATA SOURCE.

LABEL: M3 COMMERCIAL PRODUCED OR OTHER PROJECT DEVELOPED (OPD) COMMERCIAL PRODUCED WITH LOW V, I, O FOR THIS APPLICATION.

LABEL: M4 PROJECT DEVELOPED OR OTHER PROJECT DEVELOPED INSTRUMENT WITH MODERATE V, I, O FOR THIS APPLICATION.

LABEL: M5 COMMERCIAL PRODUCED WITH MODERATE V, I, O OR OTHER INSTRUMENT WITH HIGH V, I, O FOR THIS APPLICATION.

LABEL: M6 COMMERCIAL PRODUCED INSTRUMENT WITH HIGH V, I, O FOR THIS APPLICATION.

LABEL: M7 PROJECT DEVELOPED (PD) PROJECT DEVELOPED INSTRUMENT.

LABEL: M8 LOW, MODERATE OR HIGH.

VALIDITY, RELIABILITY, OBJECTIVITY, LOW, MODERATE OR HIGH.

RESEARCH PROFILING FLOW CHART
DATA QUALITY - MEASUREMENT

LABEL: M9 COMMERCIAL PRODUCED OR OTHER PROJECT DEVELOPED INSTRUMENT WITH LOW V, I, O FOR THIS APPLICATION.
RESEARCH PROFILING FLOW CHART
ANALYSIS

IDENTIFY & LIST EACH STATISTICAL ANALYSIS CONDUCTED.

CHECK CHART "A" FOR ITEMS IN ROW LABELED "NOMINAL." LIST THOSE ITEMS NOT FOUND IN THE REPORT.

LABEL: M LIST OF MISSING ANALYSIS ELEMENTS.

CHECK CHART "A" FOR ITEMS IN ROW LABELED "ORDINAL." LIST THOSE ITEMS NOT FOUND IN THE REPORT.

LABEL: L LIST OF MISSING ANALYSIS ELEMENTS.

CHECK CHART "A" FOR ITEMS IN ROW LABELED "INTERVAL OR RATIO." LIST THOSE ITEMS NOT FOUND IN THE REPORT.

LABEL: I INAPPROPRIATELY ANALYZED

END

LABEL: A APPROPRIATELY ANALYZED

ARE THE DATA ON A NOMINAL, ORDINAL, OR INTERVAL SCALE?

LABEL: A APPROPRIATELY ANALYZED
LABEL: I INAPPROPRIATELY ANALYZED

DESCRIBE THE PURPOSE OF THE ANALYSIS TO: DESCRIBE, SHOW ASSOCIATION, OR SUPPORT AN INFERENC?

LABEL: A APPROPRIATELY ANALYZED
LABEL: I INAPPROPRIATELY ANALYZED

DETERMINE THE SCALAR NATURE OF THE TWO VARIABLES AND CHECK CHART "P" FOR THE APPROPRIATE STATISTIC.

ARE THERE 2 OR MORE VARIABLES?

LABEL: A APPROPRIATELY ANALYZED
LABEL: I INAPPROPRIATELY ANALYZED

DO THE DEPENDENT & INDEPENDENT VARIABLES AND NO. IN EACH CATEGORY, CHECK CHART "C" FOR THE APPROPRIATE STAT.

LABEL: A APPROPRIATELY ANALYZED
LABEL: I INAPPROPRIATELY ANALYZED

IS THAT STATISTIC USED IN THIS STUDY?

LABEL: A APPROPRIATELY ANALYZED
LABEL: I INAPPROPRIATELY ANALYZED

CHARTS A & B
### Chart A

**Population Descriptors**

<table>
<thead>
<tr>
<th>Nominal</th>
<th>Distribution</th>
<th>Central Tendency</th>
<th>Dispersion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency in each category</td>
<td>Mode</td>
<td></td>
</tr>
<tr>
<td>Ordinal</td>
<td>Frequency in each scalar position</td>
<td>Median</td>
<td>Semi-interquartile range</td>
</tr>
<tr>
<td>Interval/Ratio</td>
<td>Frequency in each interval</td>
<td>Mean</td>
<td>Standard deviation</td>
</tr>
</tbody>
</table>

### Chart B - Measures of Association

**Variable 1**

<table>
<thead>
<tr>
<th>Continuous</th>
<th>Forced Dichotomy</th>
<th>Dichotomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous</td>
<td>Pearson $r$</td>
<td>Biserial $r$</td>
</tr>
<tr>
<td>Forced Dichotomy</td>
<td>Biserial $r$</td>
<td>Tetrachoric $r$</td>
</tr>
<tr>
<td>Dichotomy</td>
<td>Point Biserial $r$</td>
<td>None available</td>
</tr>
</tbody>
</table>

* Interval Data

Special Case 2 Variables

Rank Data Spearman's Rho

Special Case More Than 2 Variables

Interval Data Multiple $R$

Ordinal Data Kendall's $W$

Nominal Data Contingency Coeff. $C$
<table>
<thead>
<tr>
<th>DEPENDENT VARIABLE(s)</th>
<th>NOMINAL 1</th>
<th>NOMINAL&gt;1</th>
<th>ORDINAL 1</th>
<th>ORDINAL&gt;1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FISHERS EXACT PROB. FOR 2x2 TABLE</td>
<td>MC NEAMER'S TEST FOR SIGNIFICANCE OF CHANGES</td>
<td>CHISQUARE TEST FOR INDEPENDENCE</td>
<td>MANN-WHITNEY U TEST</td>
</tr>
<tr>
<td></td>
<td>FISHERS EXACT PROB. FOR 2x2 TABLE</td>
<td>MC NEAMER'S TEST FOR SIGNIFICANCE OF CHANGES</td>
<td>CHISQUARE TEST FOR INDEPENDENCE</td>
<td>MANN-WHITNEY U TEST</td>
</tr>
<tr>
<td></td>
<td>FISHERS EXACT PROB. FOR 2x2 TABLE</td>
<td>MC NEAMER'S TEST FOR SIGNIFICANCE OF CHANGES</td>
<td>CHISQUARE TEST FOR INDEPENDENCE</td>
<td>MANN-WHITNEY U TEST</td>
</tr>
<tr>
<td></td>
<td>FISHERS EXACT PROB. FOR 2x2 TABLE</td>
<td>MC NEAMER'S TEST FOR SIGNIFICANCE OF CHANGES</td>
<td>CHISQUARE TEST FOR INDEPENDENCE</td>
<td>MANN-WHITNEY U TEST</td>
</tr>
</tbody>
</table>

Most of the measures shown are located with reference to the lowest order of data that should be used with them. One should always be able to transform the observed data downward i.e. transform interval data to ordinal or nominal, ordinal can be considered nominal.
<table>
<thead>
<tr>
<th>NOMINAL &gt; 1</th>
<th>ORDINAL 1</th>
<th>ORDINAL &gt; 1</th>
<th>INTERVAL 1</th>
<th>INTERVAL &gt; 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIZE OF CHANGES</td>
<td>SIGN TEST</td>
<td>MANN-WHITNEY U TEST</td>
<td>ANALYSIS OF VARIANCE</td>
<td>HOTELLING'S T²</td>
</tr>
<tr>
<td>RELATED PROPORTIONS</td>
<td>FREIDMAN'S 2WAY ANOVA</td>
<td>FREIDMAN'S 2WAY ANOVA</td>
<td>FREIDMAN'S 2WAY ANOVA</td>
<td></td>
</tr>
<tr>
<td>ABILITY OF CORRECT CLASSIFICATION</td>
<td>INDEX OF ORDER ASSOCIATION</td>
<td>ANALYSIS OF VARIANCE WITH TREND ANALYSIS</td>
<td>ANALYSIS OF VARIANCE</td>
<td></td>
</tr>
<tr>
<td>FREIDMAN'S 2WAY ANOVA</td>
<td>ANALYSIS OF VARIANCE</td>
<td>REGRESSION ANALYSIS</td>
<td>MULTIPLE REGRESSION ANALYSIS</td>
<td></td>
</tr>
<tr>
<td>ANALYSIS OF VARIANCE</td>
<td>ANALYSIS OF VARIANCE</td>
<td>MULTIPLE DISCRIMINANT ANALYSIS</td>
<td>MULTIPLE DISCRIMINANT FUNCTION</td>
<td></td>
</tr>
<tr>
<td>ANALYSIS OF COVARIANCE</td>
<td>MULTIPLE DISCRIMINANT FUNCTION</td>
<td>MULTIPLE DISCRIMINANT FUNCTION</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*located with reference to the text used with them. One should observe data downward i.e. interval, ordinal can be*  

This table is an adaptation of Takurooka and Tiedeman's Table 1 to "Statistics As An Aspect of Scientific Method in Research on Teaching" pgs. 194-195 in HANDBOOK OF RESEARCH ON TEACHING, R. L. Gay (Ed). Rand McNally, Chicago, 1963, 1218pp.
RESEARCH PROFILE SHEET

REPORT TITLE: ________________________________

AUTHOR ___________________ SOURCE: ____________________

STOP The report is either not research or it is an incomplete part of the research process.

1 LOGIC
— Q Answer to an Empirical Question
— Hs Stop, illogical relationship in the test of the hypothesis.
— Hnc No conclusion can be reached from this test of the hypothesis.
— Hq Hypothesis is questionable.
(Rival hypotheses must be considered a cause of the consequents)
— Hc Hypothesis is credible.
(Rival hypotheses may be considered a cause of the consequents)
— Hv Hypothesis is verified.
(Rival hypotheses cannot be considered as a cause of the consequents)

2 DATA QUALITY - REPRESENTATIVENESS
— R1 An unidentified group of subjects was studied.
— R2 Volunteers were studied.
— R3 Purposive sampling from a specified population established the group studied.
— R4 Random selection from a specified population established the group studied.
— R5 The entire population was studied.

3 DATA QUALITY - TREATMENT
— T1 No theory; something undefined happened to the units studied.
— T2 No theory; treatment description incomplete, or detailed elsewhere.
— T3 No theory; treatment described in detail in the report.
— T4 Theory stated but no controls on variables.
— T5 Theory stated, mediating variables controlled.
— T6 Theory stated, mediating variables controlled, and techniques used to distribute possible extraneous variances.

4 DATA QUALITY - MEASUREMENT
— M1 Available information indicates instrument is invalid for this use.
— M2 Project Developed instrument with low validity (V), reliability (R), objectivity (O), or other instrument with no info about validity or data source.
— M3 Used "Commercially" Produced-or-Other-Project-Developed instrument with low V, R, O for this application.
— M4 Used Project, Developed instrument or Other-Project Developed instrument with moderate V, R, O for this application.
— M5 Used instrument which was Project Developed with high V, R, O or Commercially Produced with moderate V, R, O for this application.
— M6 Used Commercially Produced instrument with high V, R, O for this application.

5 STATISTICAL ANALYSIS
— A Appropriately analyzed
— I Inappropriately analyzed
— M Missing items - incomplete analysis