



Lecture 10

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Analysis of Variance and Co-variance

- **ANALYSIS OF VARIANCE (ANOVA)** ANOVA is essentially a procedure for testing the difference among different groups of data for homogeneity.

Testing of Hypotheses-II (Nonparametric or Distribution-free Tests)

○ are important and generally used:

(i) one-sample sign test.

(ii) two-sample sign test, Fisher-Irwin test, Rank sum test, etc.

(iii) Rank correlation, *Kendall's coefficient of concordance and other tests for dependence.*

(iv) test analogous to ANOVA viz., Kruskal-Wallis test.

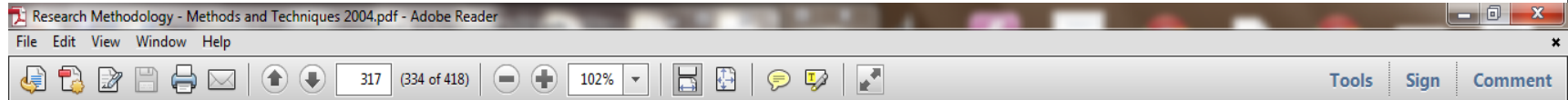
(v) Tests of randomness of a sample based on the theory of runs viz., one sample runs test.

Multivariate Analysis Techniques

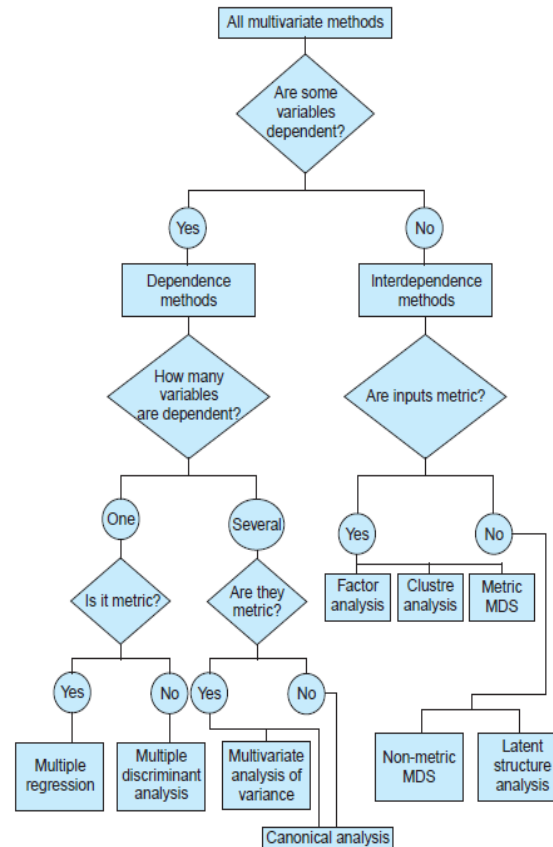
All statistical

- Of late, multivariate techniques have emerged as a powerful tool to analyze data represented in terms of many variables.
- The main reason being that a series of univariate analysis carried out separately for each variable may, at times, lead to incorrect interpretation of the result.

Thus, we have two types of multivariate techniques: one type for data containing both *dependent and independent variables*, and the other type for data containing several variables without dependency relationship.



(both metric and non-metric) and the latent structure analysis.



Interpretation and Report Writing

After collecting and analyzing

- **DIFFERENT STEPS IN WRITING REPORT**
- Research reports are the product of slow, painstaking, accurate inductive work. The usual steps involved in writing report are:
 - (a) logical analysis of the subject-matter;
 - (b) preparation of the final outline;
 - (c) preparation of the rough draft;
 - (d) rewriting and polishing;
 - (e) preparation of the final bibliography;
 - (f) writing the final draft.
- Though all these steps are self explanatory, yet a brief mention of each one of these will be appropriate for better understanding.

TYPES OF REPORTS

Research reports

- **(A) Technical Report**

In the technical report the main emphasis is on (i) the methods employed, (ii) assumptions made in the course of the study, (iii) the detailed presentation of the findings including their limitations and supporting data.

A general outline of a technical report can be as follows:

1. *Summary of results*: A brief review of the main findings just in two or three pages.
2. *Nature of the study*: Description of the general objectives of study, formulation of the problem in operational terms, the working hypothesis, the type of analysis and data required, etc.

TYPES OF REPORTS

Research reports

3. *Methods employed: Specific methods used*

4. *Data: Discussion of data collected, their sources, characteristics and limitations. If secondary*

5. *Analysis of data and presentation of findings: The analysis of data and presentation of the*

findings of the study with supporting data in the form of tables and charts be fully narrated. This, in

fact, happens to be the main body of the report usually extending over several chapters.

6. *Conclusions: A detailed summary of the findings and the policy implications drawn from the results be explained.*

7. *Bibliography: Bibliography of various sources consulted be prepared and attached.*

8. *Technical appendices: Appendices be given for all technical matters relating to questionnaire,*

mathematical derivations, elaboration on particular technique of analysis and the like ones.

9. *Index:*

(B) Popular Report

- The popular report is one which gives emphasis on simplicity and attractiveness. We give below a general outline of a popular report.
- 1. *The findings and their implications*: Emphasis in the report is given on the findings of most practical interest and on the implications of these findings.
- 2. *Recommendations for action*: Recommendations for action on the basis of the findings of the study is made in this section of the report.
- 3. *Objective of the study*: A general review of how the problem arise is presented along with the specific objectives of the project under study.
- 4. *Methods employed*: A brief and non-technical description of the methods and techniques used, including a short review of the data on which the study is based, is given in this part of the report.
- 5. *Results*: This section constitutes the main body of the report wherein the results of the study are presented in clear and non-technical terms with liberal use of all sorts of illustrations such as charts, diagrams and the like ones.
- 6. *Technical appendices*: More detailed information on methods used, forms, etc. is presented in the form of appendices. But the appendices are often not detailed if the report is entirely meant for general public.

The Computer: Its Role in Research

- **The Computer is of the most versatile and ingenious developments of the modern technological age. Today people use computers in almost every walk of life.**

In general, all computer systems can be described as containing some kind of input devices, the CPU and some kind of output devices. Figure 15.1 depicts the components of a computer system and their inter-relationship:

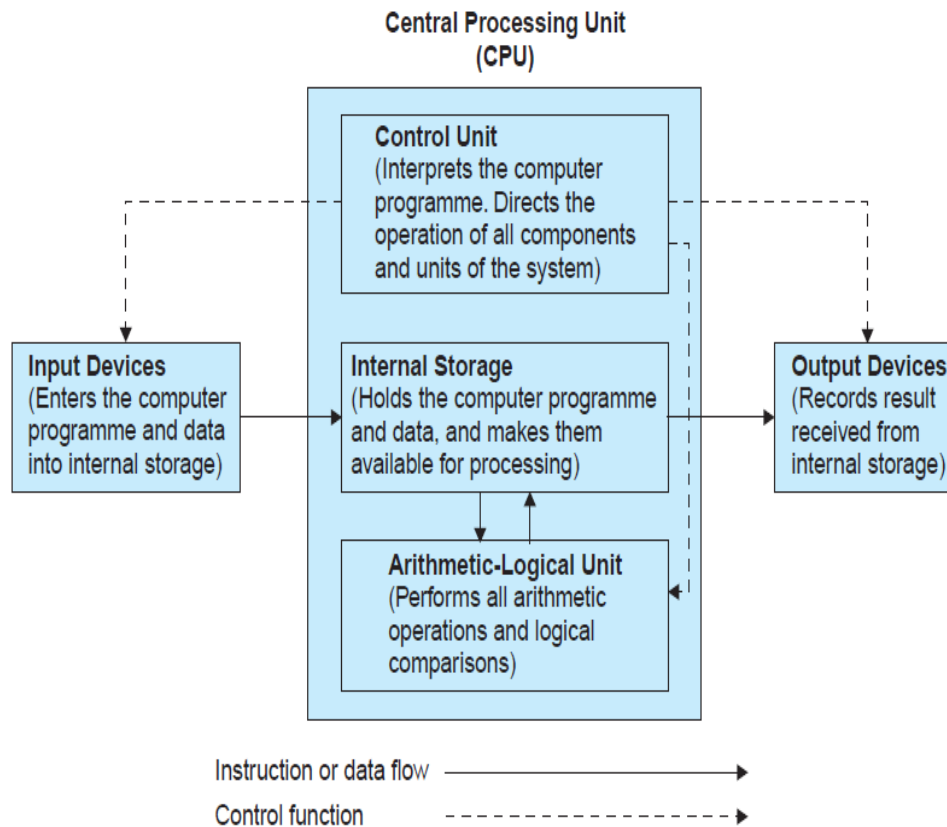


Fig. 15.1

Selected References and Recommended Readings

- 1. Ackoff, Russell L., *The Design of Social Research*, Chicago: University of Chicago Press, 1961.
- 2. Ackoff, Russell L., *Scientific Method*, New York: John Wiley & Sons, 1962.
- 3. Allen, T. Harrell, *New Methods in Social Science Research*, New York: Praeger Publishers, 1978.
- 4. Anderson, H.H., and Anderson, G.L., *An Introduction to Projective Techniques and Other Devices for Understanding the Dynamics of Human Behaviour*, New York: Prentice Hall, 1951.
- 5. Anderson, T.W., *An Introduction to Multivariate Analysis*, New York: John Wiley & Sons, 1958.
- 6. Bailey, Kenneth D., "Methods of Social Research," New York, 1978.
- 7. Baker, R.P., and Howell, A.C., *The Preparation of Reports*, New York: Ronald Press, 1938.
- 8. Bartee, T.C., "Digital Computer Fundamentals," 5th Ed., McGraw-Hill, International Book Co., 1981.
- 9. Barzun, Jacques, and Graff, Henry, F., *The Modern Researcher*, rev. ed., New York: Harcourt, Brace & World, Inc., 1970.
- 10. Bell, J.E., *Projective Techniques: A Dynamic Approach to the Study of Personality*, New York: Longmans Green, 1948.
- 11. Bellenger, Danny N., and Greenberg, Barnett A., *Marketing Research—A Management Information Approach*, Homewood, Illinois: Richard D. Irwin, Inc., 1978.
- 12. Berdie, Douglas R., and Anderson, John F., *Questionnaires: Design and Use*, Metuchen N.J.: The Scarecrow Press, Inc., 1974.
- 13. Berelson, Bernard, *Content Analysis in Communication Research*, New York: Free Press, 1952.
- 14. Berenson, Conard, and Colton, Raymond, *Research and Report Writing for Business and Economics*, New York: Random House, 1971.
- 15. Best, John W., and Kahn, James V., "Research in Education," 5th Ed., New Delhi: Prentice-Hall of India Pvt. Ltd., 1986.
- 16. Bhattacharya, Srinibas, *Psychometrics & Behavioural Research*, New Delhi: Sterling Publishers Pvt. Ltd., 1972.
- 17. Boot, John C.G., and Cox, Edwin B., *Statistical Analysis for Managerial Decisions*, 2nd ed. New Delhi: McGraw-Hill Publishing Co. Ltd., (International Student Edition), 1979.
- 18. Bowley, A.L., *Elements of Statistics*, 6th ed. London: P.S. King and Staples Ltd., 1937.

- 19. Burgess, Ernest W., "Research Methods in Sociology" in Georges Gurvitch and W.E. Moore (Ed.), *Twentieth Century Sociology*, New York: New York Philosophical Library, 1949.
- 20. Chance, William A., *Statistical Methods for Decision Making*, Bombay: D.B. Taraporevala Sons & Co. Pvt. Ltd., 1975.
- 21. Chaturvedi, J.C., *Mathematical Statistics*, Agra: Nok Jhonk Karyalaya, 1953.
- 22. Chou, Ya-Lun, *Statistical Analysis with Business and Economic Applications*, 2nd ed. New York: Holt, Rinehart & Winston, 1974.
- 23. Clover, Vernon T., and Balsley, Howard L., *Business Research Methods*, Columbus, O.: Grid, Inc., 1974.
- 24. Cochran, W.G., *Sampling Techniques*, 2nd ed. New York: John Wiley & Sons., 1963.
- 25. Cooley, William W., and Lohnes, Paul R., *Multivariate Data Analysis*, New York: John Wiley & Sons., 1971.
- 26. Croxton, F.E., Cowden, D.J., and Klein, S., *Applied General Statistics*, 3rd ed., New Delhi: Prentice-Hall of India Pvt. Ltd., 1975.
- 27. Dass, S.L., *Personality Assessment Through Projective Movie Pictures*, New Delhi: S. Chand & Co. (Pvt.) Ltd., 1974.
- 28. Davis, G.B., "Introduction to Computers," 3rd ed., McGraw-Hill International Book Co., 1981.
- 29. Deming, W. Edwards., *Sample Design in Business Research*, New York: John Wiley & Sons., Inc., 1960.
- 30. Dennis, Child, *The Essentials of Factor Analysis*, New York: Holt, Rinehart and Winston, 1973.
- 31. Denzin, Norman, *The Research Act*, Chicago: Aldine, 1973.
- 32. Edwards, Allen, *Statistical Methods*, 2nd ed., New York: Holt, Rinehart & Winston, 1967.
- 33. Edwards, Allen L., *Techniques of Attitude Scale Construction*, New York: Appleton-Century-Crofts, 1957.
- 34. Emory, C. William, *Business Research Methods*, Illinois: Richard D. Irwin, Inc. Homewood, 1976.
- 35. Ferber, Robert (ed.), *Handbook of Marketing Research*, New York: McGraw-Hill, Inc., 1948.
- 36. Ferber, R., and Verdoorn, P.J., *Research Methods in Economics and Business*, New York: The Macmillan Company, 1962.
- 37. Ferguson, George A., *Statistical Analysis in Psychology and Education*, 4th ed., New York: McGraw-Hill Book Co., Inc., 1959.
- 38. Festinger, Leon and Katz, Daniel (Eds.), *Research Methods in the Behavioral Sciences*, New Delhi: Amerind Publishing Co. Pvt. Ltd., Fourth Indian Reprint, 1976.
- 39. Fiebleman, J.K., *Scientific Method*, Netherlands: Martinus Nijhoff, The Hague, 1972.
- 40. Fisher, R.A., *Statistical Methods for Research Workers*, 13th ed., New York: Hafner Publishing Co., 1958.
- 41. Fisher, R.A., *The Design of Experiments*, 7th rev. ed., New York: Hafner Publishing Co., 1960.
- 42. Fox, James Harold, *Criteria of Good Research*, Phi Delta Kappa, Vol. 39 (March 1958).
- 43. Freedman, P., *The Principles of Scientific Research*, 2nd ed., New York: Pergamon Press, 1960.
- 44. Fruchter, Benjamin, *Introduction to Factor Analysis*, Princeton, N.J.: D.Van Nostrand, 1954.
- 45. Gatner, Elliot S.M., and Cordasco, Francesco, *Research and Report Writing*, New York: Barnes & Noble, Inc., 1956.
- 46. Gaum, Carl G., Graves, Harold F., and Hoffman, Lyne, S.S., *Report Writing*, 3rd ed., New York: Prentice-Hall, 1950.
- 47. Ghosh, B.N., *Scientific Methods and Social Research*, New Delhi: Sterling Publishers Pvt. Ltd., 1982.
- 48. Gibbons, J.D., *Nonparametric Statistical Inference*, Tokyo: McGraw-Hill Kogakusha Ltd., (International Student Edition), 1971.