AID AND GUIDE PACKAGE FOR STATISTICS AND BIOMETRY 200
(BEHAVIORAL OBJECTIVES PACKET)

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Abstract

Suggestions are made for handling the material presented in Statistics and Biometry 200. These are given for each chapter and each topic. Key words and phrases are listed to pin-point the items of most importance in the course.

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What, another mass on handouts?

Not just any conglomeration of dittos, but a set of behavioral objectives for STATISTICS and BIOMETRY 200, Statistics and Society.

A set of what?

Behavioral (or instructional) objectives.

Okay, I give up. Just what is a behavioral objective?

A behavioral objective is a specific statement of learning outcomes expressed in performance terms from the learner's viewpoint. Simply, a statement of what the learner/student should be able to do upon completion of instruction. When you read this set of objectives you'll see that each one is characterized by three basic features, and possibly a fourth. Each objective:

1. deals with a specific performance,
2. is expressed from the learner's point of view,
3. has a performance statement (what the learner is to do).

In addition, some objectives contain references to special conditions under which the learner is expected to perform (these are often in the form of "given" statements).

So what am I supposed to do with these objectives?

Basically, anything your heart desires. Students have completed this course without them in the past, and you probably can too; however, you may want to hang on to them to use in reviewing for tests and as a self-evaluation of where you stand in understanding the course material required of you.

Oh, so they are kind of like review sheets?

No, no, no, that's not what they are. The ideal thing to do with them is read them every once in a while as the course progresses and get a feel for what is required of you from previous instruction. You may want to read them before lectures and sections so you get a grasp of what is required of you and then ask questions when you don't understand something you know is required. You may want to read them tonight — if you have already mastered the objectives you should consider taking a more advanced statistics course. Reading these objectives from time to time will serve as a cumulative review for the exams — once you have mastered an objective, that will be one less thing you have to worry about for the exams.

So if I can master all the objectives, I should get a perfect score on every test?

No, that's not really true. There are going to be bugs in the system. I've probably missed a few required behaviors that will eventually show up on a test, and I'm sorry about that. I'll go out on a limb and say that if you can master these instructional objectives you should do fairly well on the exams, but don't take this as an absolute truth.

If I use these objectives will I do better on the exams than someone who isn't using them?

As much as I would like to say yes, I cannot tell a lie. There have been several studies done on the role of behavioral objectives in improving student performance. Some studies have shown that objectives improve performance in the classroom, others have demonstrated that objectives are insignificant in learning performance; however, no studies have shown that behavioral objectives impair learning and cause a deterioration in classroom performance. As much as I want to say they will improve performance, I will restrain myself and say that, at the very least, they can't hurt.

What if I have a question about what an objective is exactly asking for?

Well, many of the objectives are complemented with examples (found at the end of the objectives) that should clarify what is expected of the student. But if you still have questions, ask a fellow student, a teaching assistant or Dr. Federer . . . someone will be able to help you out. In addition, I'll try to relate the assigned homework problems to the objectives as another outlet for demonstrating what is expected of the student. There's one thing I should clarify right now. Several objectives require the student to distinguish between two or more related terms/experssions. To distinguish between related items involves the ability to define each item on its own and then compare these definitions to deduce the differences of the terms. In terms of test items, the ability to define each item separately will often be sufficient, but don't say I didn't warn you if you're asked to compare/contrast two related items.

Are these objectives organized in any way, shape or form?

Yes, as a matter of fact, they are. I've tried to separate the course material into distinct units of related material; however, the student should be forewarned that there is often an overlap of concepts — any unit may involve previously stated objectives, as well as the specific objectives stated for that course of study. Most of the objectives are also characterized by <u>key words</u> that should assist the student in organizing the material and in referring to lecture notes and the text.

Anything else?

Yes. I would appreciate your comments on these objectives. Your gut reaction to them. Have they positively contributed to your performance (in your opinion)? Have they made the course "easier" by telling you just what is required of the student? Like I said before, this is the first attempt at behavioral objectives in this course — your comments will be used to improve the objectives for future use. I think that's all I have to say for now, thanks for your time.

Jon Angellotti

Statistical Concepts

The student should be able to:

1. define survey
2. distinguish between population / universe and sample
3. distinguish between census and sample survey
4. distinguish between parameter and statistic

Measurement

The student should be able to:

1. define measurement and measuring device
2. describe the nine forms of measurement listed in the text, given the names of these nine forms
3. identify the assignable and non-assignable causes of variation that compose a general measurement/response
4. define error of measurement by identifying its components
5. distinguish between precision and accuracy
6. illustrate the difference between precision and accuracy by constructing an example as given in the text

Data Collection

The student should be able to:

1 define datum / data
2. describe the eight aspects of data collection
3. distinguish between the six categories of phony statistics
4. classify a given example as being one of these six categories by naming the correct category of phony statistic represented by the example
5. properly scrutinize any given statistic by presenting arguments for/against the justification of the statistic

Principles of Scientific Investigation

The student should be able to:

1. define science and scientific inquiry
2. distinguish between hypothesis, theory and law
3. distinguish between research and re-search

4. distinguish between empirical research and analytic research
5. distinguish between deductive inference and inductive inference
6. identify a given example as representing either deductive or inductive inference
7. define experiment
8. describe the process of model building
9. define treatment
10. identify the treatment represented in a given example
11. distinguish between an absolute/ single phenomenon experiment and a comparative experiment
12. classify a given example as being either an absolute or comparative experiment
13. distinguish between treatment design and experimental design
14. distinguish between experimental unit and observational unit
15. identify the experimental unit and observational unit represented in a given example
16. describe the eight principles of scientific investigation
17. identify the portions of a given example/passage that refer to each of the principles of scientific investigation
18. interrelate the eight principles of scientific investigation with the eight steps of data collection

Survey and Survey Design

The student should be able to:

1. distinguish between sampling unit and sampling frame
2. identify the sampling unit and sampling frame represented in a given example
3. define sample survey and sample survey design
4. describe the thirteen steps involved in planning a survey
5. identify the sections of a given example/passage that refer to each of the thirteen steps of planning a survey
6. distinguish between the five types of non-probability survey design
7. identify a given example as one of the five types of non-probability survey design
8. distinguish between probability survey design and non-probability survey design
9. distinguish between the eight types of probability survey design presented in class

10. define simple random sample
11. distinguish between strata, cluster and area
12. distinguish between equal allocation and proportional allocation
13. identify a given example as a specific type of probability survey design
14. identify, within the constructs of a given example, the sampling frame, sampling unit and observational unit
15. identify, in an applicable example, the stratum/ strata and type of allocation represented

Response Equations

The student should be able to:

1. recall, in words, the response equation for each type of probability survey design
2. identify the assignable and non-assignable sources of variation within each response equation
3. represent an arithmetic mean in symbolic notation
4. represent a deviation in symbolic notation
5. select the proper subscript notation for a given response equation
6. translate a worded response equation into a symbolic equation

Random Allotment

1. Given a random number table, the student should be able to obtain a random ordering of the numbers 0 through 9.
2. Given a random number table, the student should be able to obtain a random ordering of the numbers 0 through 19.
3. The student should be able to describe the procedure used to obtain the above random orderings.

Experimental Design

The student should be able to:

1. define experimental unit
2. define replication
3. compute an arithmetic mean
4. describe the constructs of the completely randomized design (crd)
5. describe the constructs of the randomized complete blocks design (rcbd)

6. define blocking
7. define orthogonality of effects
8. conclude, from a given example, whether two effects are orthogonal or not
9. describe the constructs of the balanced incomplete blocks design (bibd)
10. define balance
11. conclude, from a given example, whether or not the experimental design is balanced
12. define confounding (complete and partial)
13. determine, from a given example, whether the design is completely, partially or not confounded
14. describe the constructs of the simple change-over design (scod)
15. describe the constructs of the latin square design (lsd)
16. describe the constructs of the Youden design
17. describe the constructs of the F-square design
18. describe the constructs of designs to measure residual (carry-over) effects
19. recall the response equations (in words) for each of the above listed experimental designs
20. identify the assignable and non-assignable sources of variation for the response equations of each design
21. translate these worded response equations into symbolic response equations
22. determine whether or not the assignable effects are orthogonal for each design
23. determine whether or not the assignable effects are balanced for each design
24. describe a randomization procedure used for each design
25. recall the three desirable characteristics of experimental design and and the two reasons why they should be included in an experimental design
26. recall the six principles of design and their interrelation
27. recall the three criteria of design
28. interrelate the three criteria of design and the six principles of design
29. define efficiency
30. recall the two main purposes of randomization in experimental design
31. classify a given design as a specific example of one of the presented types of experimental design
32. write out the proper experiment design when presented with a given situation

Given an example of a crd, the student should be able to:

1. compute the required arithmetic means
2. compute the estimated overall mean for the sample
3. compute the estimated treatment effects
4. compute the estimated random errors for each observation
5. reconstruct and compute any single observation from its component effects of the response equation

Given an example of an rcbd, the student should be able to:

1. compute the required arithmetic means
2. compute the estimated overall mean for the sample
3. compute the estimated treatment effects
4. compute the estimated block effects
5. compute the estimated random errors for all observations
6. reconstruct and compute any single observation from its component effects of the response equation

Given an example of a bibd, the student should be able to determine:

b = number of blocks
k = size of blocks
v = number of treatments
r = number of experimental units per treatment
λ = number of times each treatment pair occurs

Given an example of a scod or an example of a lsd, the student should be able to:

1. compute the required arithmetic means
2. compute the estimated overall mean for the sample
3. compute the estimated treatment effects
4. compute the estimated row effects
5. compute the estimated column effects
6. compute the estimated random errors for all observations
7. reconstruct and compute any single observation from its component effects of the response equation

Treatment Design

The student should be able to:

1. distinguish between experimental design and treatment design

2. recall the use of control / standard treatments in an experiment
3. identify an example of a control / standard treatment in an experiment
4. distinguish between independent and dependent factors in an experiment
5. identify, given an example, the independent and dependent factors involved in the experiment
6. describe the constructs of a factorial treatment design
7. list all possible treatments represented by a given factorial design
8. describe the constructs of a fractional factorial treatment design
9. classify a given example as a fractional factorial design
10. compute, given the responses of a factorial design:
    the overall mean
    the main factor effects
    the interaction effects
11. compute, given the overall mean, factor main effects and interaction effects, the original responses of the factorial design
12. identify, given a specific factorial design and the original responses, graphs of two-way interactions, three-way interactions and zero-way interactions
13. assign a factorial treatment design to a given experimental situation
14. select the proper treatment design for a given situation
15. identify the correct response equation, given the estimated effects of a factorial treatment design
16. recall the uses of the diallel-cross design
17. identify examples of the diallel-cross design

Bioassay

The student should be able to:

1. define bioassay
2. distinghish between the slope-ratio assay and the parallel-line assay
3. graphically represent a slope-ratio assay and a parallel-line assay
4. compute the relative potency of the test preparation from both the slope-ratio and parallel-line assays
5. identify the correct response equations for the test and standard preparations in both the slope-ratio and parallel-line assays
6. select the proper form of assay to be used in a given situation/example

Graphical Summarization of Data

The student should be able to identify examples of:

1. one-way and two-way tabular arrays
2. cheating charts or graphs
3. extrapolation beyond data points
4. interpolation between data points
5. graphs where axes are unlabelled, unmarked, undefined or not clearly labelled, marked or defined
6. the following types of graphs:
   - ideographs
   - pie charts
   - pictograms
   - horizontal bar graphs
   - horizontal line graphs
   - vertical bar graphs
   - vertical line graphs
   - stem and leaf diagrams
   - histograms
   - frequency polygons

Probability

The student should be able to:

1. define event / possible outcome
2. define and identify:
   - elementary event
   - compound event
   - mutually exclusive events
   - equally likely events
   - independent events
   - conditional events
3. distinguish between analytic probability and empirical probability
4. recall the addition law of probability and select it to compute a probability of an elementary or compound event in a given example
5. recall the multiplication law of probability and select it to compute a probability of an elementary or compound event in a given example
6. recall the conditional law of probability and select it to compute a probability of an elementary or compound event in a given example
7. represent a factorial expression as a series of products
8. recall the law of independent events and select it to compute a probability of an elementary or compound event in a given example

9. assign the rules of counting to compute the total number of possible events in a given situation
10. represent the rules of counting as a tabular array
11. compute the probabilities of elementary and compound events from this tabular array
12. distinguish between permutations and combinations
13. recall the formula for permutations
14. compute the number of permutations for a given example
15. recall the formula for combinations
16. compute the number of combinations for a given example

Measures of Location and Dispersion

The student should be able to:

1. define the following measures of central tendency:
   the sum of n items
   the median of n items
   the mode of n items
   arithmetic mean
   harmonic mean
   geometric mean
   percentages or proportions
   trimmed means or medians
2. define the following measures of dispersion/variation:
   range
   average of absolute deviations
   variance
   standard deviation
   standard error of a mean
   coefficient of variation
3. recall computing formulas and compute the following for a given single sample of observations:

sample sum	sample variance
sample mean	degrees of freedom
sample median	sample standard deviation
sample mode	standard error of the mean
sample range	coefficient of variation

4. recall computing formulas and then compute the following for a given example of a crd, a stratified-simple random sample design or a cluster-simple random sample design:

treatment means	standard error of treatment means
treatment medians	treatment coefficients of variation
treatment ranges	pooled variance degrees of freedom
overall/pooled mean	pooled variance
modes for all data	variance of a mean
treatment residuals	standard error of a mean
treatment variances	standard error of difference of two means
treatment degrees of freedom	average coefficient of variation
treatment standard deviations	
treatment effects	

5. recall computing formulas and compute the following for a given example of a rcbd:

overall mean	degrees of freedom for pooled variance
treatment means	pooled variance
treatment effects	sample standard deviation
block means	standard error of a mean
block effects	standard error of difference of two means
residuals	average coefficient of variation

6. recall computing formulas and then compute the following for a given example of a lsd or a given example of a scod:
   - overall mean
   - treatment means
   - treatment effects
   - row means
   - row effects
   - column means
   - column effects
   - residuals
   - degrees of freedom for pooled variance
   - pooled variance
   - sample standard deviation
   - standard error of difference or two means
   - average coefficient of variation
   - standard error of a mean
7. distinguish between an asymmetrical and symmetrical frequency distributions
8. classify a given frequency distribution as asymmetrical or symmetrical
9. given either an asymmetrical or symmetrical frequency distribution, identify points of the graph representative of the distribution's:
   - median
   - mode
   - mean
   - minimum value
   - maximum value

Interval Estimation

The student should be able to:

1. define confidence interval
2. identify a confidence interval
3. apply the confidence belt charts to compute confidence intervals for a given proportion $\hat{p}$ and a given sample size n