

9 SEPT 2015

1. ANATOMY OF A STUDY - URQUHART

2. CLIENT MEETINGS

- FRIDAY - ANDREW NELSON - INC RNA
- MONDAY - FRANCINE GACHUPIN
AMER INDIAN OBESITY PREVENTION

3. NEXT TIME

- MEETINGS
- ASKING QUESTIONS
- NEGOTIATING.

ANATOMY OF A STUDY

RESEARCH STUDY - SEEKS TO DESCRIBE HOW A PARTICULAR RESPONSE CHANGES WITH FEATURES OF THE RESEARCH SETTING.

3 ESSENTIAL PARTS

- RESPONSE
- STRUCTURE TO WHICH WE WANT TO RELATE RESPONSE
- STRUCTURE TO MINIMIZE EFFECTS OF EXTRANEEOUS VARIATION

- RESPONSE DESIGN
- TREATMENT DESIGN
- EXPERIMENTAL (VARIATION CONTROL) DESIGN

EXAMPLE: WATER QUALITY

- MUMS USED AS ASSAY ORGANISM
- WATER OBTAINED FROM 24 SOURCES
DISTILLED → TAP → BRACKISH → ^{SULPHUR} SPRING
- MUMS GROWN IN POTS (360) IN RESEARCH GREENHOUSE
- POTS ON 3 BENCHES
24 GROUPS OF 5 POTS ON EACH BENCH
- EACH WATER SOURCE RANDOMLY ALLOCATED TO A GROUP 5 POTS ON EACH BENCH. SEPARATE RANDOMIZATION PER BENCH.

EXAMPLE - CONT'D

CONSIDER $\left\{ \begin{array}{l} 1 \text{ CUTTING} \\ 4 \text{ CUTTINGS} \end{array} \right\}$ PER POT

EVALUATED AFTER 7 WEEKS.

PLANT HEIGHT EVALUATED AS THE RELEVANT VARIABLE.

TREATMENT DESIGN - HOW DO THE 24 WATER SOURCES
RELATE TO ONE ANOTHER?

EXPERIMENTAL DESIGN - TREATMENT ASSIGNMENT
RESTRICTED - EACH WATER SOURCE APPEARS ON
THE SAME NUMBER OF POTS ON EACH BENCH

EXPERIMENTAL UNIT ?

RESPONSE DESIGN - 1 CUTTING PER POT \rightarrow POT
IS THE RESPONSE UNIT. (NESTED RESP. DESIGN)
4 PER POT \rightarrow 2 LEVEL NESTED RESP. DESIGN.
4 PLANTS/POT, 5 POTS PER EU.

SUPPOSE WEEKLY REPEATED MEASUREMENTS
OF EACH PLANT FOR 5 WEEKS. (BEGINNING IN
WEEK 3)

VS.

SUPPOSE EACH WEEK (BEGINNING @ WEEK 3)
ONE POT IS RANDOMLY SELECTED FROM EACH
EU AND HEIGHT IS MEASURED.

GENERAL STRUCTURE

EU - EXPERIMENTAL UNIT - AMOUNT OF MATERIAL TO WHICH WE APPLY A TREATMENT

SOME "TREATMENTS" CANNOT BE APPLIED, BUT ARE A CHARACTERISTIC OF THE EXPT'L MATERIAL.

→ "CHARACTERISTIC TREATMENTS"

→ NEED TO DISTINGUISH BETWEEN EXPERIMENTS & OBSERVATIONAL STUDIES.

POPULATION - WELL-DEFINED SET OF OBJECTS FOR WHICH INFERENCES ARE SOUGHT.

TREATMENTS INDEX POPULATIONS.

- TRT DESCRIBE THE FEATURES OF POP'NS WE WISH TO COMPARE VIA THE RESPONSE

TREATMENT IS A GENERAL TERM.

- ALT. DEFN: EU IS THE ELEMENT WE SELECT AT RANDOM FROM A POP'N

TREATMENT DESIGNS

- SPECIFY THE STRUCTURE OF HOW TREATMENTS RELATE TO EACH OTHER.

UNSTRUCTURED

- FIXED - DRUGS, GROUP ID, - USE MULTIPLE COMPARISONS
- RANDOM - LOCATION, YEARS, - USE COMPONENTS OF VARIANCE ANIMALS

STRUCTURED

- GROUPING OR NESTED - SOME RELATION BETWEEN GROUPS
EGFR INHIBITORS VS. ANGIOGENESIS INHIB.
- GRADIENT/REGRESSION - DOSE, DILUTION SERIES
- FACTORIAL - MULTIPLE FACTORS WITH ANY OF PREVIOUS STRUCTURES.
→ FRACTIONAL FACTORIAL DESIGN (VARIATION CONTROL?)
→ RESPONSE SURFACE DESIGNS

- ATTENTION IS FOCUSED ON COMPARISONS AMONG TREATMENTS
- KEY PART OF ANY RESEARCH STUDY
- DOMINATES THE STATISTICAL ANALYSIS
- RESEARCHERS ARE REALLY GOOD AT THIS PART.

ANALYSIS OF - FIXED VS. RANDOM
- STRUCTURED VS. UNSTRUCTURED



EXPERIMENTAL DESIGN (VARIATION CONTROL DESIGN)

- SPECIFIES THE RELATION BETWEEN TREATMENTS AND EXPERIMENTAL UNITS
- USUALLY MANIFESTED THROUGH THE RANDOMIZATION PLAN (RESTRICTION)
- SUBJECT MATTER KNOWLEDGE SHOULD BE TAKEN INTO ACCOUNT THROUGH RANDOMIZATION
 - KNOWN SOURCES OF EXPERIMENTAL HETEROGENEITY
 - BATCH EFFECTS (MEASUREMENT)
 - SEE FIG 1 IN PAPER.
- ALL THE "NAMES" YOU LEARNED IN EXPERIMENTAL DESIGN

COMPLETELY RANDOM DESIGN
 RANDOMIZED COMPLETE BLOCK DESIGN
 LATIN SQUARE
 SPLIT PLOT, [~~FRACTIONAL FACTORIAL~~
 BALANCED INCOMPLETE BLOCK; PBIB]
 COMBINE TRT + EXP DESIGNS.

NET EFFECT

- MINIMIZE THE EFFECT OF KNOWN, BUT UNINTERESTING, SOURCES OF VARIATION
- IT CAN AFFECT HOW TO ESTIMATE TREATMENT EFFECTS.
- MOSTLY IT AFFECTS METHODS FOR ESTIMATING VARIANCES

RESPONSE & RESPONSE DESIGN

6

RESPONSES (MEASUREMENTS, VARIABLES) SHOULD CHARACTERIZE THE ATTRIBUTES OF INTEREST IN THE POPULATION

- MOST STAT METHODS BEGIN BY ASSUMING AVAILABILITY (AND DIST'N) OF RESPONSE
- THIS THE RESPONSE AND ITS MEASUREMENT ARE FREQUENTLY IGNORED BY STATISTICIANS (THIS IS BAD!)

TYPES OF RESPONSES

- DISCRETE - TWO TYPES: NOMINAL CATEGORIES, COUNTS
- CONTINUOUS
 - ORDINAL
 - INTERVAL (RELATIVE?)
 - ABSOLUTE

→ CONSIDER: 1 kg vs 2 kg
AND 1000 kg vs 1002 kg } $\Delta \stackrel{?}{=} 1 \text{ kg}$

- STATISTICAL PROBLEM FORMULATION RELIES ON THIS DECISION,
- STATISTICAL THEORY OF "RESPONSES" (MEASUREMENT) SEEMS LESS WELL DEFINED THAN OTHER AREAS
- MEASUREMENT SYSTEM CHARACTERIZATION IS MISSING.

"TO MEASURE IS TO KNOW."

"THE TROUBLE WITH MEASUREMENT IS ITS SEEMING SIMPLICITY"

LORD KELVIN

PULLING PARTS TOGETHER.

- SEE FIG 2.
- DF. PARTITIONING.

FINAL THOUGHTS

- STATISTICAL EXPT'L DESIGN STARTED IN AGRICULTURE → RESPONSE USUALLY STRAIGHT-FORWARD
 - ↳ MAY EXPLAIN LACK OF ATTENTION TO RESPONSE DEVELOPMENT IN MOST STATS DEPARTMENTS/ DISCIPLINES.
 - ↳ BETTER TREATMENT IN BEHAVIORAL SCIENCES.
- OFTEN, TREATMENTS "COME WITH" EXPERIMENTAL UNITS (e.g. THEY ARE SAMPLED FROM A POP'N OF INTEREST)
- THIS CAN LEAD TO COMPLICATIONS (CONFOUNDING)

$$24 \text{ WATER SOURCES} \times 3 \text{ BENCHES} = 72 \text{ EU}$$

$$\frac{5 \text{ POTS/EU}}{360 \text{ TOTAL}}$$

72 {

<u>SOURCE</u>	<u>df</u>	
MEAN	1	
BENCHES	2	
WATER SOURCES	23	
ERROR A	46	(GROUPS OF POTS W/i WATER SOURCES)

POTS WITHIN EU

288

72(5-1) ←

SUBSAMPLING
≡ "ERROR B"

THE FALLACY OF P-VALUES, THE TYRANNY OF 0.05, PRAISE TODAY'S BAYES.

WHAT WHY THIS TALK

WHAT DO I WANT YOU TO TAKE HOME (DO DIFFERENTLY)

• MANY

PULLING PARTS TOGETHER

- SEE FIGS.

- OF PARTITIONING

FINAL THOUGHTS

- STATISTICAL EXP'T DESIGN STAYED IN

ASSISTANCE → RESPONSE USUALLY STRAIGHT-FORWARD

→ MAY EXPLAIN LACK OF ATTENTION

TO RESPONSE DEVELOPMENT IN MOST

STAT DEPARTMENTS / DISCIPLINES

→ BETTER TREATMENT IN BEHAVIORAL SCIENCES

- OFTEN, TREATMENTS "COME WITH" EXPERIMENTAL

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