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Social Science Research Methods

Dr. Peter R. Gillett

Associate Professor

Department of Accounting & Information Systems

Rutgers Business School – Newark & New Brunswick

Overview

- Properties of Estimators
- Ipsative Scales
- References
- Moderation, Mediation and Suppression
- Correlation
- A Critique of Steers and Braunstein

Properties of Estimators

- Many probability models are indexed by *parameters*
- E.g.
  - Binomial – p
  - Poisson – l
  - Normal – m and s
- Generally, we will use q to represent some (unknown) parameter

Properties of Estimators

- We estimate unknown parameters from sample data using statistics – i.e., functions of the random variables
- Suppose, $f_X(x; q)$ is the probability model
- Suppose $X_1, X_2, \ldots, X_n$ are a random sample
- Let $W = h(X_1, X_2, \ldots, X_n)$ be a statistic used to estimate q

Properties of Estimators

- W is *unbiased* if, on average, it is equal to the parameter estimated; i.e., E(W) = q
- Thus $E(\overline{X}) = m$ where $\overline{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$
- $E(S^2) = s^2$ where $S^2 = \frac{1}{n}\sum_{i=1}^{n}\left(X_i - m\right)^2$
- $E(s^2) = s^2$ where $s^2 = \frac{1}{(n-1)}\sum_{i=1}^{n}\left(X_i - \overline{X}\right)^2$

Properties of Estimators

- The *relative efficiency* of two estimators W_1 and W_2 is given by $\mathrm{Var}(W_1) / \mathrm{Var}(W_2)$
- Recall that:
  - The Cramer-Rao Inequality sets a lower bound for the variance of an estimator
  - An estimator is *best* if it has the minimum variance of all unbiased estimators
  - An estimator is *efficient* if it achieves the Cramer-Rao lower bound

Properties of Estimators

- Sometimes we can find efficient estimators; e.g., $\overline{X}$ is efficient
- On other occasions, there is no efficient estimator, and we must settle for a best estimator
- OLS estimators are *BLUE*

  *B*est *L*inear *U*nbiased *E*stimators

Properties of Estimators

- W is *consistent* (for q) if it converges in probability to q;

  i.e., $P(|W_n - q| < e) > 1 - d$ for $n > n(e, d)$

- A consistent estimator is *asymptotically unbiased*, and its variance converges to 0

Ipsative Scales

- Measurement again!
- Ipsative scales are self-referenced
- Sometimes called “forced choice formats”
  - In practice this usually means that the total of raw scores is constant
    - E.g., “indicate which characteristics of your Instructor impress you the most by allocating 100 points across the following: intelligent, insightful, passionate, creative, short”
    - E.g., “Suppose you have $1000 to invest; how would you divide it between stocks A, B and C”
- Essentially ordinal
- Represent *relative* strength
- Designed to reduce biases such as central tendency, acquiescence, soocial dersirabilty, low self-esteem, etc.
- Mean item intercorrelations are negative
- Reliabilities are reduced
- Problem ameliorated when more items (30 or more?)
- Factor analysis is particularly problematic

Moderation, Mediation and Suppression

- Moderator variables
  - Qualitative or quantitative variable that affects the direction and/or strength of the relation between an independent or predictor variable and a dependent or criterion variable
  - Essentially, representable as an interaction
    - Moderator hypothesis is supported if the interaction term is significant
  - Moderator variables always function as independent variables, whereas mediators shift roles from effects to causes . . .

Moderation, Mediation and Suppression

- Moderator variables
  - Most commonly we suppose, and investigate dichotomous or linear moderation effects
  - If we have explicit (theoretical?) non-linear moderation hypotheses (e.g. quadratic) we can investigate them explicitly
  - Otherwise (e.g., step functions), we can "dichotomize" at points of non-linearity
  - Generally, however, we will use significance of interaction term in regression models to test for moderation (generalizing all four of Baron & Kenny's cases . . .)
  - $Y = \alpha + \beta_1 X + \beta_2 Z + \beta_3 X \bullet Z$

Moderation, Mediation and Suppression

- Mediator variables
  - A variable may be said to function as a mediator to the extent that it accounts for the relation between the predictor and the criterion
  - Because the independent variable is assumed to cause the mediator, they should be correlated
  - Using multiple regression to test mediator hypotheses assumes
    - No measurement error in the mediator
    - The dependent variable does *NOT* cause the mediator

Moderation, Mediation and Suppression

- Mediator variables
  - The variable M (fully) mediates the effect of variable X on variable Y iff
    - X → Y
    - X→ M
    - M→Y
    - X, M → Y but X is not significant

Moderation, Mediation and Suppression

- Moderator variables are typically introduced when there is an unexpectedly weak or inconsistent relation between a predictor and a criterion
- Mediation is best done in the case of a strong relation between the predictor and the criterion
- In Baron & Kenny's discussion of investigations ranging from moderation to mediation, note the role played by weak or absent theory!
- Do not allow their discussion of *mediated moderation* and/or *moderated mediation* to obfuscate the distinction for you!

Moderation, Mediation and Suppression

- This paper's clear and most valuable contribution for us is the clarity of the distinction and the simplicity of testing for either moderation or mediation – however, do not neglect the importance of proper incorporation of moderators or mediators into your theoretical models – they should be an integral part of the story you have to tell . . .

Moderation, Mediation and Suppression

- Suppressor variables
  - A variable acts as a suppressor when it has zero (or close to zero) correlation with the criterion but is correlated with one or more of the predictors
  - Suppressor variables measure invalid variance in the predictor measures and serve to suppress this invalid variance
  - Accounting for suppressor variables increases the partial correlations between predictors and criterion because it *suppresses* (or controls for) irrelevant variance
  - Thus examining zero order correlations with the criterion is not necessarily a good way to choose explanatory variables
  - When included in the analysis, suppressor variables often have a negative *b* coefficient

Correlations

- Pearson Product-Moment Correlation
  - Two continuous variables
- Point-Biserial Correlation
  - One continuous variable and one categorical variable
- Phi coefficient
  - Two categorical variables

- Spearman Rank-Correlation
  - Product moment applied to ranks instead of score
- Etc.

Part Correlation and Partial Correlation

- Zero order correlations
  - r_{xy}
  - r_{xz}
  - r_{yz}

Part Correlation and Partial Correlation

- Partial correlation
  - $r_{xy.z}$
  - The correlation between x and y after removing the linear effects of z
  - Regress x on z and y on z
  - Compute the regression estimates x' and y'
  - Compute the residuals $e_x = x - x'$ and $e_y = y - y'$
  - $r_{xy.z} = r_{e_x e_y}$
  - (Note that, of course, $r_{e_x z} = r_{e_y z} = 0$)

Part Correlation and Partial Correlation

- Partial correlation
  - Higher order partial correlation
  - $r_{xy.uvw}$
  - The correlation of x and y after removing the linear effects of u, v, and w

Part Correlation and Partial Correlation

- Partial correlation
  - Multiple correlations
  - $r^2_{xy.z} = (R^2_{x.yz} - R^2_{x.z}) / (1 - R^2_{x.z})$
  - $r^2_{xy.uvw} = (R^2_{x.yuvw} - R^2_{x.uvw}) / (1 - R^2_{x.uvw})$
  - Etc.

Part Correlation and Partial Correlation

- Whether or not partial correlations are useful or appropriate depends on your theoretical assumptions
- E.g., partial correlations are inappropriate when your model assumes x → y → z or y → x and y → z
- E.g., when considering the effect of a child's intelligence on academic achievement, we want to control for the parents' intelligence; however, partial correlations remove the effect of parental intelligence on the child's intelligence, and this is generally not what we want . . .
- If two variables essentially measure the same thing, we may end up partialling a relation out of itself . . .
- Note that the correction for attenuation discussed in earlier classes is essentially a use of partial correlations

Part Correlation and Partial Correlation

- Semipartial (or part) correlations
  - Removal of the linear effects of variables from one but not both of the variables being correlated
  - $r_{x(y.z)} = r_{x\,e_y}$ is the correlation with x after the linear effects of z have been removed from y
  - $r^2_{x(y.z)} = R^2_{x.yz} - R^2_{x.z}$
  - Significance can therefore be tested using an F test
  - Often used in examining incremental explanatory power from adding variables to an existing model

Part Correlation and Partial Correlation

- Natural extensions of the partial and semipartial correlations we have examined arise from multiple partial and multiple semipartial correlations
- E.g.
  - $R^2_{x.yz(uv)} = (R^2_{x.yzuv} - R^2_{x.uv}) / (1 - R^2_{x.uv})$
  - $R^2_{x(yz.uv)} = R^2_{x.yzuv} - R^2_{x.uv}$

A Critique and Defense

- "A Behaviorally-Based Measure of Manifest Needs in Work Settings" Richard M. Steers & Daniel N. Braunstein Journal of Vocation Behavior 9, 251-266 (1976)

A Critique and Defense

- Critique
  - Four needs from Murray are measured – why these four; what are the consequences of omitting the others?
  - Murray's theory is not reviewed so we cannot fully understand the constructs to be measured
  - The theory is supposedly that motivated behavior is a function of the strength of various needs at a given point in time – but the paper does not address *stability* of the measures
  - Concurrent validity?
  - Reverse scoring used for only 25% of items – is this enough?
  - How are Likert scales converted into scores and how are item-correlations computed?

A Critique and Defense

- Critique
  - The first study uses managements students – does this compromise external validity?
  - Relatively few items supports the aim of brevity but presumably compromises reliability?
  - Table 2 supposedly shows highly acceptable association between MNQ and PRF for n Ach and n Dom. Surely at 0.61 and 0.62 this is an overstatement of convergent validity? Note also that they do not give measures of statistical significance for this table

A Critique and Defense

- Critique
  - The authors claim a high degree of congruence between theory and research of Murray's needs and point-biserial correlations between MNQ scores and subject choices of work group characteristics. Since they do not cite the theory and research we cannot assess this claim. Still, none of the correlations is high, and so claims for predictive validity are suspect.
  - Test-retest validity – were the 41 students used random? Perseveration may have overstated reliability for such a brief instrument. We are not told what measure is used – (domain sampling would be more relevant than true and error scores, so Cronbach's alpha would be best choice)

A Critique and Defense

- Critique
  - How representative are subjects in second study?
  - What are effects of complexity of the second study, with three questionnaires? Were order effects controlled for?
  - Second and third studies focus on independence of four scales – why was this not important in the first study?
  - Presentation of results is unconvincing: " the various scales are generally not closely related . . . those high correlations that do exist are suggested by theory and have been found elsewhere"
  - Table 5 is supposedly consistent with theory and earlier findings – but we cannot assess this
  - No corrections for attenuation used anywhere

A Critique and Defense

- Critique
  - "Median off-diagonal correlation" is ambiguous, and less than a complete analysis
  - Why is coefficient alpha not cited for 2nd and 3rd studies?
  - "Sources of attachment" are one-item measures, not known to be reliable or valid – so what is the value of Table 5?
  - No check for social desirability bias is cited
  - Column headings for Table 2 are misleading – presumably these are correlations?

A Critique and Defense

- Defense
  - Goal of brief reliable valid measures is laudable and valuable for future research
  - Reliability and face validity improved by measuring in the work environment, avoiding response bias and controlling for acquiescence and social desirability using behavior-based scales
  - Multiple judges should enhance content validity
  - Although only students were used, a wide variety of jobs supports external validity
  - Median off-diagonal correlations indicates discriminant validity (although not comprehensively investigated)

A Critique and Defense

- Defense
  - Cronbach's coefficient alpha used to assess internal consistency, with good results for n Dom
  - Subjects were initially deceived but later debriefed
  - Authors claim criterion-related validity of the instrument is established by relationships between MNQ scores and sources of attachments and criterion measures that are in accordance with the theory (although this is not convincingly presented)
  - Although many quoted correlations and arguments are only weak, there are no contradictory results cited
  - MNQ claimed to be superior to several other longer instruments, so it has a useful role in further exploratory research