

Factorial Survey Methods:

and the use of HLM, HOLIT,
HULIT, and HLIT Models

R. L. Brown, Ph.D.

rlbrown3@wisc.edu

Medical Research Consulting

Classic Reference

Rossi PH, Anderson AB. The factorial survey approach: an introduction. In Rossi PH, Nock SL, eds. *Measuring social judgments: the factorial survey approach*. Beverly Hills: Sage, 1982.

The use of vignettes in social science research has a long history, including applications in psychological research since the 1950s.

Basic Definition

Factorial Survey Methods are a technique for applying experimental design to survey research.

FS Methodology

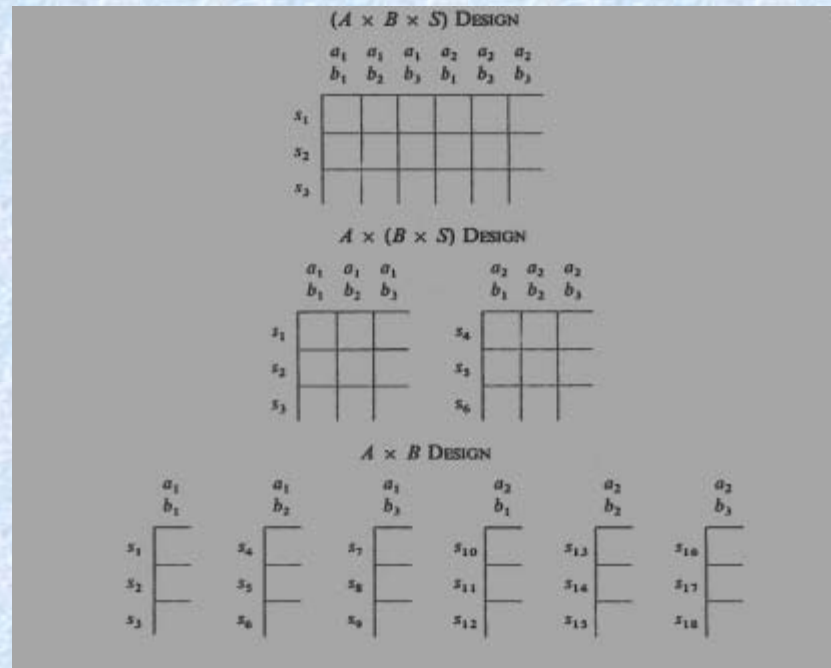
- FS has been devised to help in the unravelling of complex choices
- FS offer a better approximation to “real” cases than traditional survey questions
- FS describe fictitious persons (families, organizations, etc.) whose relevant characteristics are described in sketches.

FS Methodology (continued)

- FS are constructed using experimental design by systematically varying factors or characteristics.
- FS may allow us to investigate hard to study issues due to simulation.
- FS major limitation – reality?

Factorial Surveys typically use designs with repeated measures

2 factor designs

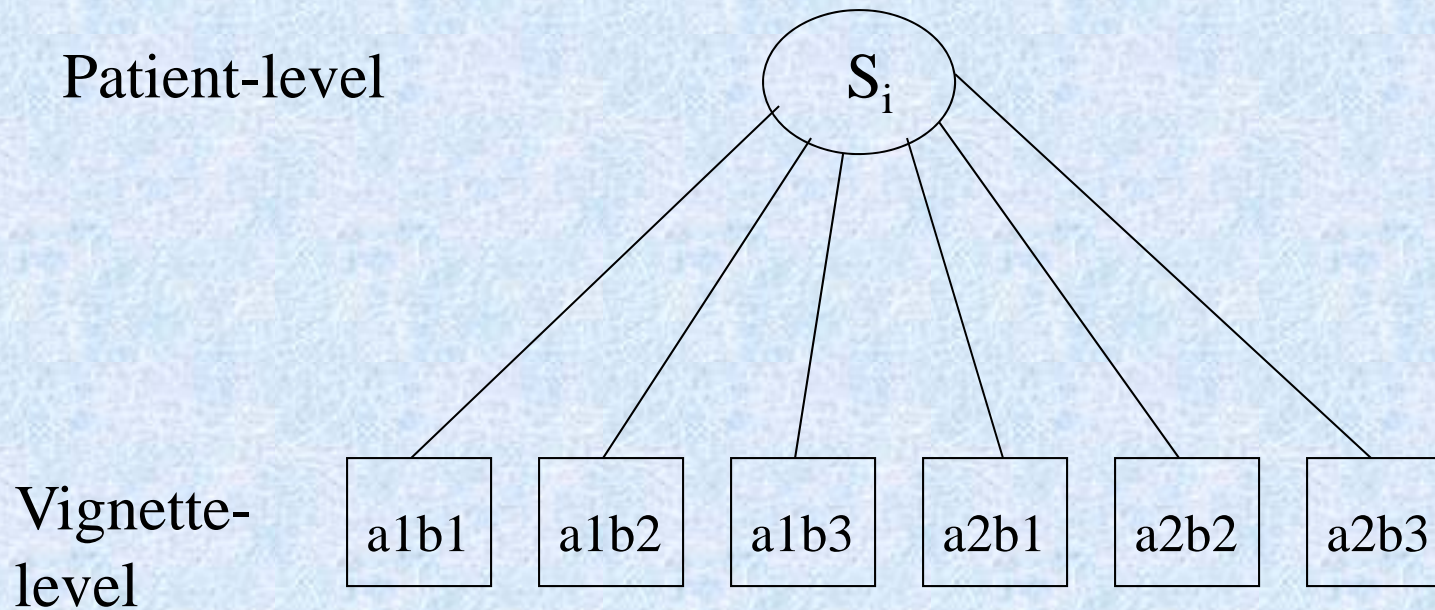


(A x B x S) Design Physician Trust

	A ₁	A ₁	A ₁	A ₂	A ₂	A ₂
	B ₁	B ₂	B ₃	B ₁	B ₂	B ₃
S ₁	4	1	2	5	6	3
S ₂	1	5	6	2	3	4
S ₃	3	4	1	6	2	5
S _k						

A = Gender of physician, B = Race of physician

$(A \times B \times S)$ Design



Repeated Measures Factorial Designs produce hierarchical or multilevel data.

Statistical Analysis

Typically we want to study the relationships between variables both within and between levels.

What's the problem with using classic general linear modeling (GLM)?

Assumptions of the GLM

- Cases are independently sampled from a normal distribution (Vignettes)
 - Vignettes are hierarchical not randomly sampled
- The covariance between individual error terms is assumed to be zero
 - Since vignettes are judged by the same subject correlation between error terms is likely.

Responses may be categorical or unlimited continuous

- Unlimited continuous = HLM (Hierarchical linear modeling)
- Binary outcome = HLIT (Hierarchical Logit modeling)
- Ordered categorical outcome = HOLIT (Hierarchical ordered logit modeling)
- Unordered categorical outcome = HULIT (Hierarchical unordered logit modeling)

Example

Brown, R. , **Brown, R. L.**, Rounds, L., Castelaz, C., and Papasouliotis, O. Physicians' decisions to prescribe Benzodiazepines for nervousness and insomnia. Journal of General Internal Medicine, 1997, 12, 44-52.

Brown, R., **Brown, R. L.**, Edwards, J., and Nutz, J. Variation in a medical faculty's decisions to transfuse: Implications for modifying blood product utilization. Medical Care, 1992; 30(12), 1083-1096.

(A x B x C x D x E x S) Design

A = Gender – 2 levels

B = Race – 2 levels

C = Psychiatric Diagnosis – 3 levels

D = Patient Health Status – 2 levels

E = Patient's Reported Alcohol Use – 3 levels

Shared Scenario

A 43-year-old hypertensive African-American woman comes to see you, her regular physician, for a second visit in four weeks. She complains of nervousness and difficulty falling asleep.

Four weeks ago your partner found that the patient was under increased stress at work. She has worked for many years at the same insurance company as an insurance claims adjuster. Two years ago she was promoted to a supervisory desk job. After an initial adjustment period, she handled her new job very well. She reports that her job has been extremely stressful lately because she was assigned to supervise more adjusters.

The patient has been married for 16 years. She has been hypertensive for five years. For the past four years she has taken enalapril 10 mg daily. She has smoked one pack of filtered cigarettes daily for 22 years. She has never used illicit drugs. She denies suicidal ideation and has not had panic attacks.

The patient's blood pressure at her visit four weeks ago was 145/95. A physical examination revealed no other abnormalities.

Your partner prescribed a benzodiazepine,* 40 doses, no refills, and referred the patient for psychological assessment and treatment. The psychologist sent you a report and recommended return visits twice a month.

Today the patient reports that the psychologist was not helpful, and she refuses to return. She states that the medication was very helpful. She requests a refill but is willing to trust your judgment. Her blood pressure is 150/92, and she appears tired and irritable.

Factor (C=3)

Psychiatric Diagnosis:

GAD indicates that the patient has several symptoms of **generalized anxiety disorder**: excessive worry on most days during the previous six months, difficulty controlling the worry, restlessness, easy fatigability, and irritability.

MDE indicates that the patient has several symptoms of **major depressive episode**: depressed mood, decreased pleasure, fatigue, and decreased ability to concentrate for two months.

ADJ indicates that the patient has marked psychological distress consistent with **adjustment disorder** and no other symptoms listed above under GAD or MDE.

Factor (D=2)

Health Status:

The patient usually has well controlled blood pressure, has no other medical problems, and takes no other medications,

OR

The patient has:

- Poorly controlled, labile blood pressure.
- Two elevated liver function tests: GGT (gamma-glutamyl transferase) 310 (*normal 20-80*); AST (aspartate aminotransferase/SGOT) 87 (*normal 10-40*).
- Chronic epigastric discomfort partially relieved with H₂ blockers. Upper GI series and abdominal ultrasound are negative.

Factor (E=3)

Patient's Report of Alcohol Use:

The patient states: "I don't drink. I never liked the taste."

OR

The patient states: "I've been recovering from alcoholism for five years. I still go to AA weekly. I abstain completely."

OR

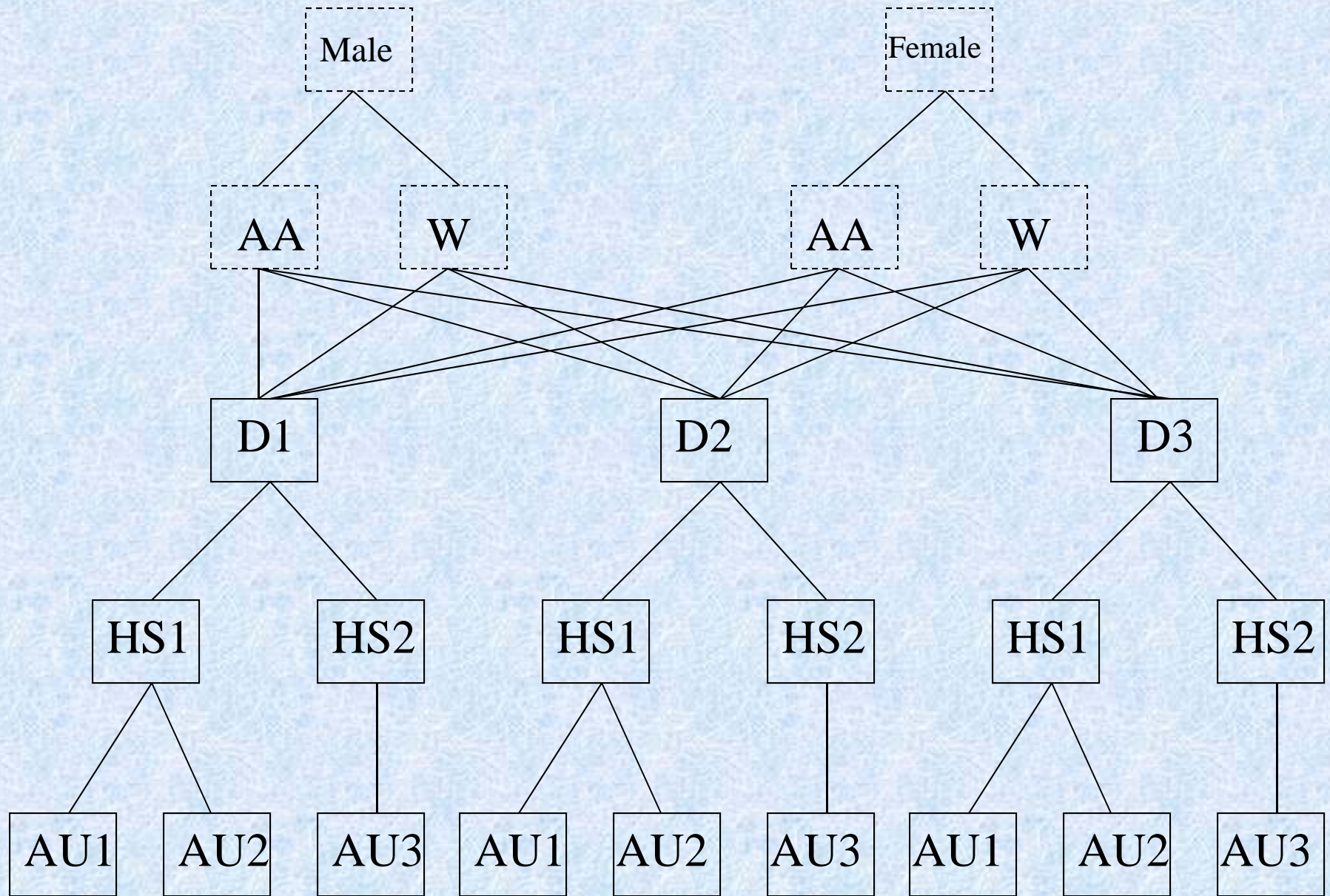
The patient states: "I have a couple of beers now and then."

Question: Would you agree to prescribe at least 40 additional doses of a benzodiazepine for the next month?

1- For each of the nine cases, please answer by checking a Yes or No box at the corresponding number on the postcard.

2- In the space provided on the card, please print the name of the benzodiazepine you would prefer to prescribe.

Case	Diagnosis	Health Status	Report of Alcohol Use
1	GAD	<ul style="list-style-type: none"> BP is well controlled with enalapril. No other medical problems. 	'I don't drink. I never liked the taste.'
2	GAD	<ul style="list-style-type: none"> BP is well controlled with enalapril. No other medical problems. 	'I've been recovering from alcoholism for five years. I still go to AA weekly. I abstain completely.'
3	GAD	<ul style="list-style-type: none"> BP poorly controlled and labile despite enalapril. Elevated GGT and AST (SGOT). Chronic epigastric discomfort partially relieved with H₂ blockers. 	'I have a couple of beers now and then.'
4	MDE	<ul style="list-style-type: none"> BP is well controlled with enalapril. No other medical problems. 	'I don't drink. I never liked the taste.'
5	MDE	<ul style="list-style-type: none"> BP is well controlled with enalapril. No other medical problems. 	'I've been recovering from alcoholism for five years. I still go to AA weekly. I abstain completely.'
6	MDE	<ul style="list-style-type: none"> BP poorly controlled and labile despite enalapril. Elevated GGT and AST (SGOT). Chronic epigastric discomfort partially relieved with H₂ blockers. 	'I have a couple of beers now and then.'
7	ADJ	<ul style="list-style-type: none"> BP is well controlled with enalapril. No other medical problems. 	'I don't drink. I never liked the taste.'
8	ADJ	<ul style="list-style-type: none"> BP is well controlled with enalapril. No other medical problems. 	'I've been recovering from alcoholism for five years. I still go to AA weekly. I abstain completely.'
9	ADJ	<ul style="list-style-type: none"> BP poorly controlled and labile despite enalapril. Elevated GGT and AST (SGOT). Chronic epigastric discomfort partially relieved with H₂ blockers. 	'I have a couple of beers now and then.'



Incomplete Factorial Design

The hierarchical logistic model poses two regression equations, one modeling the vignette effects within the respondents, and the other modeling respondent effects between respondents. First, for each respondent we model a separate within-respondent regression model:

$$\log it(\pi_{ij}) = \beta_{i0} + \sum_{p=1}^P \beta_{ip} x_{ijp},$$

where

π_{ij} = the prescribing probability for vignette i by physician j ,

x_{ijp} = the value of the vignette characteristics for vignette i and respondent j ,

β_{ip} = the regression coefficients within respondent j .

for

$i = 1, 2, \dots, k$ vignettes

$j = 1, 2, \dots, n$ respondents,

$p = 0, 1, \dots, p$ vignette variables.

Physician responses on the respondent level are subsequently predicted by the values of the corresponding vignette characteristics.

Second, each of the regression coefficients from the above model may be represented as a between-respondents model:

$$\beta_{im} = \gamma_{0m} + \gamma_{1m}z_{1i} + \dots + \gamma_{rm}z_{ri} + u_{im}$$

Where

β_{im} = the within-respondents regression coefficient for vignette characteristic m and physician respondent i,

z_{ri} = the values of the respondent characteristics for physician respondent i,

γ_{rm} = the regression coefficient that describes the effects of respondent variables on the within-respondents relationships β_{im} ,

u_{im} = random errors.

$$y_{ij} = \log it(\pi_{ij}) = \left[\sum_{r=0}^q \sum_{m=0}^p \gamma_{rm} z_{ri} \right] + \left[\sum_{m=0}^p u_{im} + \varepsilon_{ij} \right]$$

The observed (0,1) prescribing response, at level 1, is $y_{ij} \sim \text{Bin}(1, \pi_{ij})$ with Binomial variance $\pi_{ij} (1-\pi_{ij})$. This assumption of binomial variation can be tested by fitting an ‘extra-binomial parameter’ σ_e^2 , so the vignette-level variance would be $\sigma_e^2 \pi_{ij} (1-\pi_{ij})$. Estimates close to 1.00 indicate appropriateness of the binomial assumption.

Hierarchical Logistic Regression Model

Vignette Parameter	Respondent Parameter	Reference	Estimated Logit	Standard Error	Estimated Odds Ratio	Estimated 95% C.I. OR	
Fixed Parameters						LL	UL
V-constant	Constant		0.083	0.147			
	Female Phys	Male Phys.	0.281*	0.091	1.32445	1.10809	1.5830
	Younger Phys	Older Phys.	0.067	0.076	1.06930	0.92131	1.2410
	MCPR absent	MCPR present	-0.197	0.130	0.82119	0.63648	1.0595
	Black Phys	White Phys.	0.438	0.436	1.54960	0.65931	3.6421
	Hisp Phys	White Phys.	0.032	0.295	1.03252	0.57915	1.8408
	Asian Phys	White Phys.	0.200	0.190	1.22140	0.84164	1.7725
	Other Phys	White Phys.	0.227	0.345	1.25483	0.63814	2.4674
	Northeast	South	0.071	0.112	1.07338	0.86198	1.3371
	Midwest	South	0.027	0.102	1.02737	0.84121	1.2547
	West	South	-0.124	0.104	0.88338	0.72048	1.0831
	Fam Prac	Addiction Med.	0.650*	0.104	1.91554	1.56230	2.3486
	Int Med	Addiction Med.	0.554*	0.110	1.74020	1.40270	2.1589
	Psych	Addiction Med.	0.611*	0.105	1.84227	1.49960	2.2632
Depression		Gen Anx Dis	-1.780*	0.059	0.16864	0.15022	0.1893
Adj Dis		Gen Anx Dis	-0.429*	0.038	0.65116	0.60442	0.7015
Recov		No AUD	-1.403*	0.050	0.24586	0.22291	0.2711
AUD		No AUD	-1.945*	0.063	0.14299	0.12638	0.1617
Black patient		White patient	0.069	0.081	1.07144	0.91415	1.2557
Male patient		Female patient	-0.030	0.074	0.97045	0.83941	1.1212
Random Parameters			Estimated Variance	Est. S.E. Variance			
Physician Level	Constant		1.154*	0.105	-	-	
	Depression		2.589*	0.168	-	-	
	Adj Dis		0.452*	0.068	-	-	
	Recov		1.757*	0.120	-	-	
	AUD		3.511*	0.196	-	-	
	Black patient		0.034	0.139	-	-	
	Male patient		0.000	0.000	-	-	
Patient Level	Constant ^a		0.493*	0.009	-	-	

* p < .05 ^a Extra Binomial