Rating Experiment

Outline

- Procedure
- Decision Model
- Data Analysis

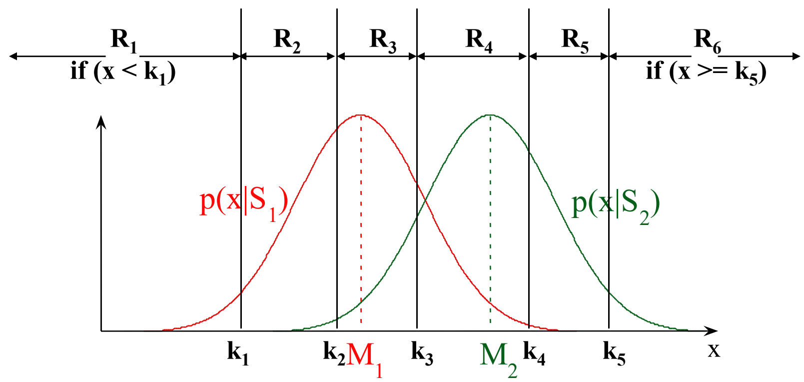
Procedure

- Same as the procedure for 1-I experiments, *except that*
- There are > 2 admissible responses
- Subjects decide not only which one of the two stimuli was perceived to have been presented, but their confidence in such decisions.

Procedure (*cont.*)

- Three types of response sets
  - Numerals – simplest
  - Verbal categories
  - 2 sub-responses
    - R_1 or R_2, then
    - Grade the certainty of response with numerals or verbal categories
- All three types are equivalent in functionality

Decision Model



$$d' = \frac{M_2 - M_1}{\sigma}$$

$$c_i = \frac{1}{\sigma}\left(k_i - \frac{M_1 + M_2}{2}\right)$$

Data Analysis

- **Stimulus-response matrix for experimental data**
- **Calculate d′**
- **Derive ROC (iso-sensitivity curve)**
- **Calculate response bias c_i**
- **The key is to find the appropriate pair of (H, F) values, then**
  - **d′ = z(H) – z(F)**
  - **c = – [z(H)+z(F)]/2**

An Example (from M&C, chap.3)

- Word recognition (old vs. new, *high-frequency vocabulary*)
- "Detection" of old words
  - Old is S2, New is S1

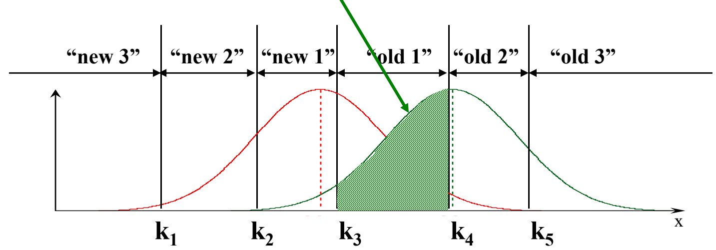
	"old 3"	"old 2"	"old 1"	"new 1"	"new 2"	"new 3"	Total
Old	49	94	75	60	75	22	375
New	8	37	45	60	113	113	376

(from Table 3.1, M&C, Chap. 3, p. 1)

Proportions

	"old 3"	"old 2"	"old 1"	"new 1"	"new 2"	"new 3"	Total
New (S_1)	.021	.098	.120	.160	.301	.301	1.00
Old (S_2)	.131	.251	.200	.160	.200	.059	1.00

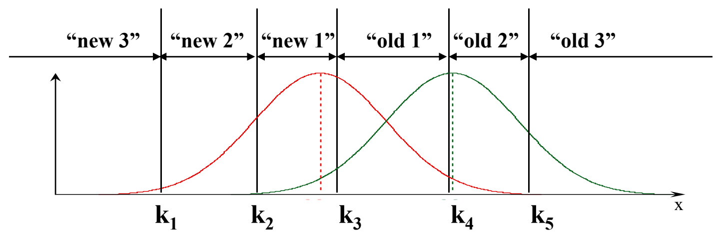
(from Table 3.2, M&C, Chap. 3, p. 3)



Cumulative Proportions: Hit and False-Alarm Rates

	"old 3" (k_5)	"old 2" (k_4)	"old 1" (k_3)	"new 1" (k_2)	"new 2" (k_1)	"new 3" ($k = -\infty$)	Total
F	.021	.119	.239	.399	.700	1.00	1.00
H	.131	.382	.582	.742	.942	1.00	1.00

(from Table 3.3, M&C, Chap. 3, p. 4)



Z-scores

	"old 3" (k_5)	"old 2" (k_4)	"old 1" (k_3)	"new 1" (k_2)	"new 2" (k_1)	"new 3" ($k = -\infty$)	Total
z(F)	- 2.035	- 1.180	- 0.705	- 0.255	0.525	–	1.00
z(H)	-1.125	- 0.300	0.205	0.645	1.575	–	1.00

(from Table 3.4, M&C, Chap. 3, p. 5)

Calculation of d′

- Two conceptually different methods
  1. Collapse the data matrix into a 2×2 matrix, by combining responses for the same stimulus

	"old 3"	"old 2"	"old 1"	"new 1"	"new 2"	"new 3"	Total
Old	49	94	75	60	75	22	375
New	8	37	45	60	113	113	376

(from Table 3.1, M&C, Chap. 3, p. 1)

	"old"	"new"
Old (S_2)	218	157
New (S_1)	90	286

	R_1	R_2
S_1	286	90
S_2	157	218

d′=0.910
c = 0.25

Calculation of d′ (cont.)

- Two methods (*cont.*)
  2. Calculate d′ from the many (H, F) values

(from Table 3.4, M&C, Chap. 3, p. 5)

	"old 3" (k_5)	"old 2" (k_4)	"old 1" (k_3)	"new 1" (k_2)	"new 2" (k_1)	"new 3" ($k = -\infty$)	Total
z(F)	- 2.035	- 1.180	- 0.705	- 0.255	0.525	–	1.00
z(H)	-1.125	- 0.300	0.205	0.645	1.575	–	1.00
d′	0.910	0.880	0.910	0.900	1.050	–	–

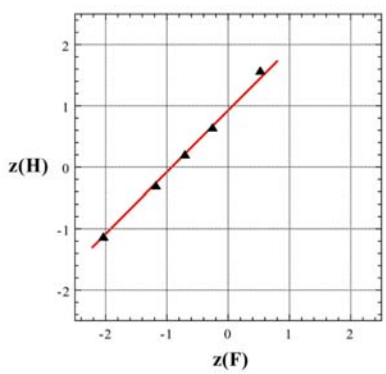
Data Analysis

- Stimulus-response matrix for experimental data
- Calculate d′
- **Derive ROC iso-sensitivity curve**
- Calculate response bias c_i
- The key is to find the appropriate pair of (H, F) values, then
  - $d' = z(H) - z(F)$
  - $c = -[z(H)+z(F)]/2$

Plotting the ROC

	k_5	k_4	k_3	k_2	k_1
z(F)	- 2.035	- 1.180	- 0.705	- 0.255	0.525
z(H)	-1.125	- 0.300	0.205	0.645	1.575

(from Table 3.4, M&C, Chap. 3, p. 5)



$z(H) = z(F) + d'$

$d' = 0.93$

(from Figure 3.1, M&C, Chap. 3)

More on Estimation of $\sigma_{d'}$

- This is the "other" way to construct a ROC curve for estimating $\sigma_{d'}$
  - See lectures notes on "how to calculate $\sigma_{d'}$"
  - Fitting based on minimum rms error is not appropriate because both abscissa and ordinate are *dependent* variables
  - Use *maximum likelihood estimation* method
  - See M&C, chap.3, p. 13, for reference to the Dorfman & Alf's algorithm

Data Analysis

- Stimulus-response matrix for experimental data
- Calculate d′
- Derive ROC iso-sensitivity curve
- **Calculate response bias c_i**
- The key is to find the appropriate pair of (H, F) values, then
  - $d' = z(H) - z(F)$
  - $c = -[z(H)+z(F)/2]$

Calculation of c_i

(from Table 3.4, M&C, Chap. 3, p. 5)

	"old 3" (k_5)	"old 2" (k_4)	"old 1" (k_3)	"new 1" (k_2)	"new 2" (k_1)	"new 3" ($k = -\infty$)	Total
z(H)	-1.125	- 0.300	0.205	0.645	1.575	–	1.00
z(F)	- 2.035	- 1.180	- 0.705	- 0.255	0.525	–	1.00
d′	0.910	0.880	0.910	0.900	1.050	–	–
c_i	1.58	0.74	0.25	-0.195	-1.05	–	–

Reading

- Chap. 3 of Macmillan and Creelman's book