

A Decision Model for Psychophysics: *Two-Interval Experiments*

Procedures for the 1-I and 2-I Exps.

One-interval

- S_1, S_2
- R_1, R_2
- $P(S_1), P(S_2)$
- R_1 for S_1, R_2 for S_2
- Payoffs (k)?
- Feedback?

	R_1	R_2
S_1		
S_2		

Two-interval

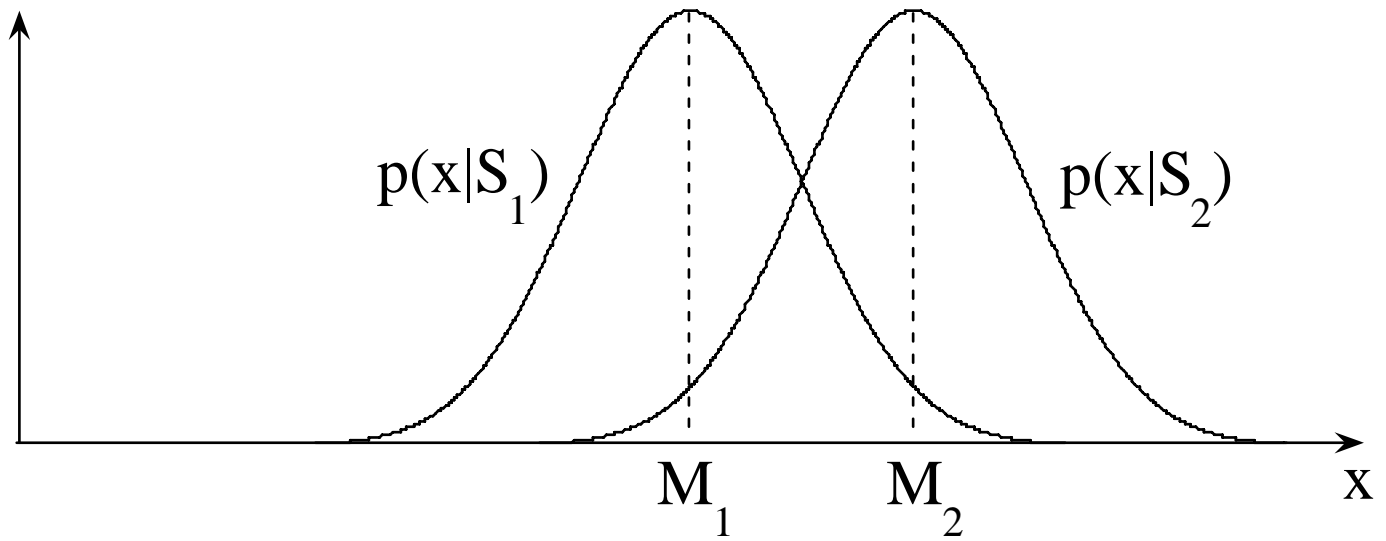
- $U_1=(S_2, S_1), U_2=(S_1, S_2)$
- R_1, R_2
- $P(U_1), P(U_2)$
- R_1 for U_1, R_2 for U_2
- Payoffs (k)?
- Feedback?

	R_1	R_2
U_1		
U_2		

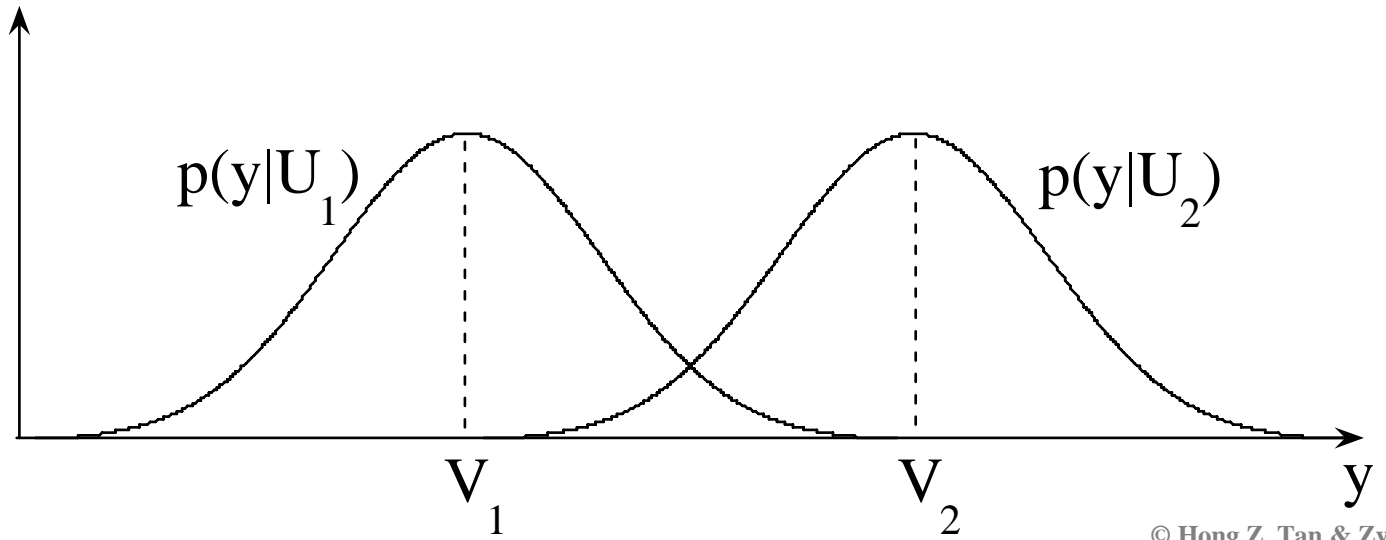
In-Class Demo: 2-I Exp.

- Go to “Online Expeirments”
- Go down to “Part II. Decision Model for Psychophysics”
- Go to “**Two**-interval Experiment”
- Select “1. Curvature detection”
- Click on “Start Experiment”
- Select the default setting of *short session, with feedback and temporal order.*

1-I



2-I



Decision Model for 2-I Experiments

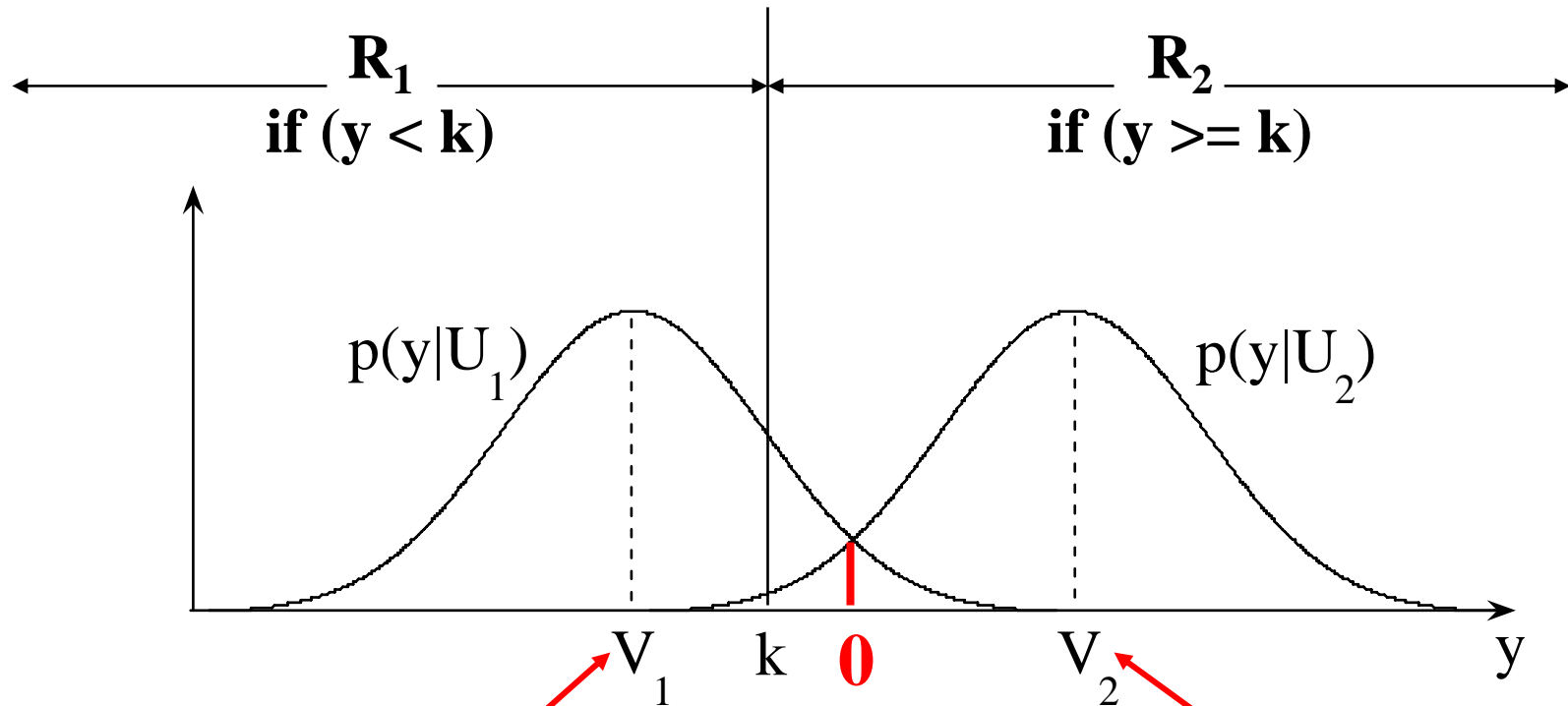
- S_1 determines x_1 , S_2 determines x_2
- $U_1=(S_2, S_1)$ determines (x_2, x_1) ,
 $U_2=(S_1, S_2)$ determines (x_1, x_2)
- **Assumption:**
 $y = x_1 - x_2$ for U_1 , $y = x_2 - x_1$ for U_2
- It follows that $V_1 = M_1 - M_2$, $V_2 = M_2 - M_1$

$$p(x|S_1) = N(M_1, \sigma^2) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-M_1)^2}{2\sigma^2}} \quad p(x|S_2) = N(M_2, \sigma^2) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-M_2)^2}{2\sigma^2}}$$

$$p(y|U_1) = N[(M_1 - M_2), 2\sigma^2]$$

$$p(y|U_2) = N[(M_2 - M_1), 2\sigma^2]$$

Decision Model for 2-I (cont.)



$$p(y|U_1) = N[(M_1 - M_2), 2\sigma^2]$$

$$p(y|U_2) = N[(M_2 - M_1), 2\sigma^2]$$

$$d'_{2I} = \sqrt{2} \frac{M_2 - M_1}{\sigma}$$

$$c_{2I} = \frac{k}{\sqrt{2}\sigma}$$

Data Analysis

	R_1	R_2
U_1		
U_2		

- Form a 2-by-2 matrix using data from a 2I-2AFC experiment
- Calculate (H, F)
- Calculate $z(H)$, $z(F)$
- Calculate d' and c
- How are the results from one-interval and two-interval experiments related?

Comparing 1-I and 2-I Results

- Given the same S_1 and S_2
 - ◆ Run a 1-I experiment
 - ◆ Run a 2-I experiment using $U_1=(S_2, S_1)$ and $U_2=(S_1, S_2)$
 - ◆ Theoretically, the results are related
 - ◆ $d'_{2I} = \sqrt{2} \times d'_{1I}$
 - ◆ $c_{2I} < c_{1I}$

Comparing Results of 1-I and 2-I *Curvature Detection Demos*

- Does the 2-I exp. *feel easier* than the 1-I exp.?
- $d'_{2I} > d'_{1I}$? By how much (ratio)?
- $c_{2I} < c_{1I}$?

Question

- $DL_{2I} = DL_{1I} ?$

$DL_{2I}=DL_{1I}?$

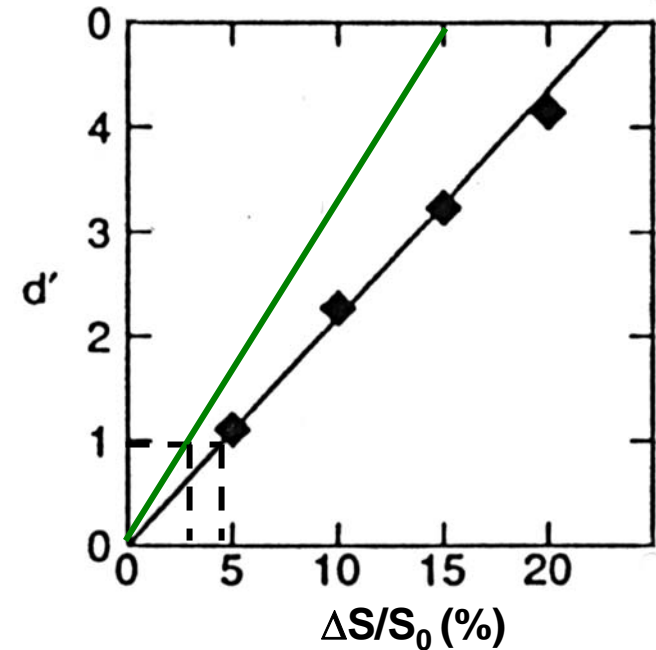
- Assuming that

- ◆ $d'_{2I} = \sqrt{2} \times d'_{1I}$
- ◆ $DL_{1I} = \Delta S @ d'_{1I} = 1$
- ◆ $DL_{2I} = \Delta S @ d'_{2I} = 1$
(or $DL_{2I} = \Delta S @ d'_{2I} = \sqrt{2}$)
- ◆ where $\Delta S = S_2 - S_1$

- Then

- ◆ $DL_{2I} = DL_{1I} / \sqrt{2}$
(or $DL_{2I} = DL_{1I}$)

- Otherwise, we don't know.



Readings

- **Chapter 7.**

**N. A. Macmillan and C. D. Creelman,
Detection Theory: A User's Guide. New York:
Cambridge University Press, 1991.**