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

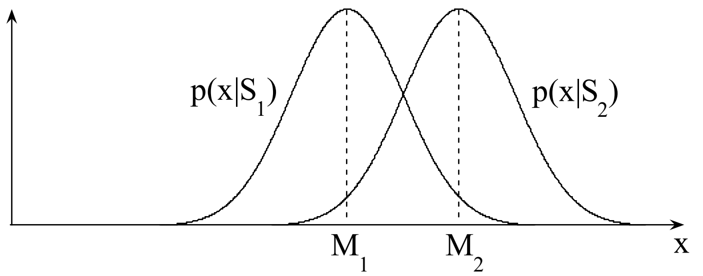
- $U_1=(S_2, S_1)$, $U_2=(S_1, S_2)$
- R_1, R_2
- $P(U_1)$, $P(U_2)$
- R_1 for U_1, R_2 for U_2
- Payoffs (*k*)?
- Feedback?

	R_1	R_2
U_1		
U_2		

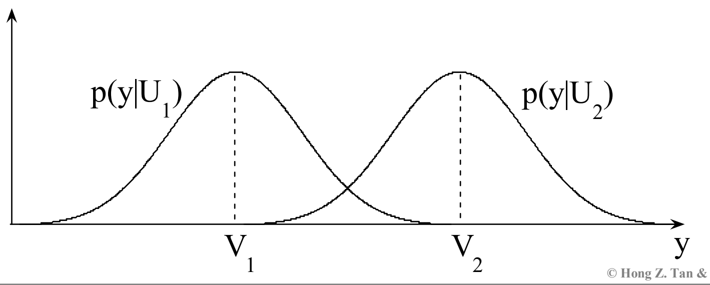
In-Class Demo: 2-I Exp.

- 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



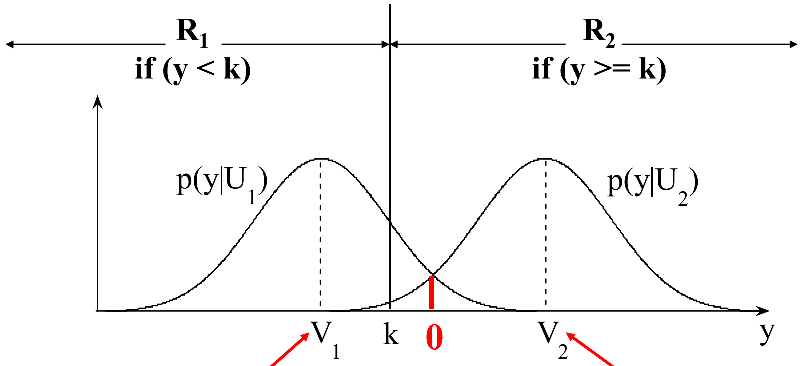
Decision Model for 2-I Experiments

- 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:**
  $y_1= x_1-x_2$ for U_1, $y_2= x_2-x_1$ for U_2
- It follows that $V_1=M_1-M_2$, $V_2=M_2-M_1$

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

$$p(y|U_1)=N[(M_1-M_2),2\sigma^2] \qquad p(y|U_2)=N[(M_2-M_1),2\sigma^2]$$

Decision Model for 2-I (cont.)



$$p(y|U_1)=N[(M_1-M_2),2\sigma^2] \qquad p(y|U_2)=N[(M_2-M_1),2\sigma^2]$$

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

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

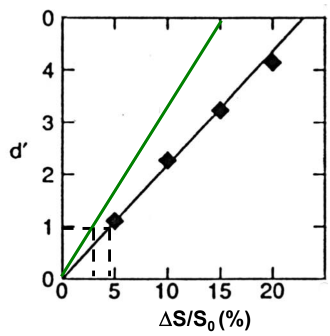
- **$DL_{2I} = DL_{1I}$?**

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.