

Data: Types

Cardinal, Ratio-scale

Can be used to generate normalized gap, M_1 , M_2

Categorical

“The numbers assigned to a category are in a real sense *simply placeholders* to convey information that can be ordered” Ex: Sanitation facilities, source of water, roof materials

Can identify deprived/non categories

Pick *any* consistent numerical scale

For variable and cutoff

Requirement: Measure independent of chosen scale

Types of Data

Ordinal

Have clear ordering of achievements

Ex: Self reported health, birth order of children

Do not know the cardinal *distance* between each level

Can identify deprived achievements via a specific achievement cutoff

Pick *any* consistent numerical scale

For variable and cutoff

Requirement: Measure independent of chosen scale

[robust to monotonic transformation]

‘Meaningful’ in sense of Roberts (1978)

Example: Unidimensional case

$$Y = (5 \ 7 \ 3 \ 9) \quad z=6; \quad g1 = (1/6, 0, 1/2, 0)$$

– With a poverty line $z=6$, we will obtain the following **P1** for the **monotonic transformations** of y :

– **P1:**

y : 0.17	→ P1 differs among the monotonic transformations of vector y
$\ln(y)$: 0.12	
y^2 : 0.26	
$y+3$: 0.11	

Example: Multidimensional case

$$Y = \begin{pmatrix} 2 & 3 & 1 & 4 \\ 4 & 2 & 2 & 3 \\ 1 & 4 & 3 & 2 \\ 3 & 1 & 4 & 1 \end{pmatrix}$$

$$z = (4 \ 3 \ 2 \ 4)$$

– **M1:** y : 0.28

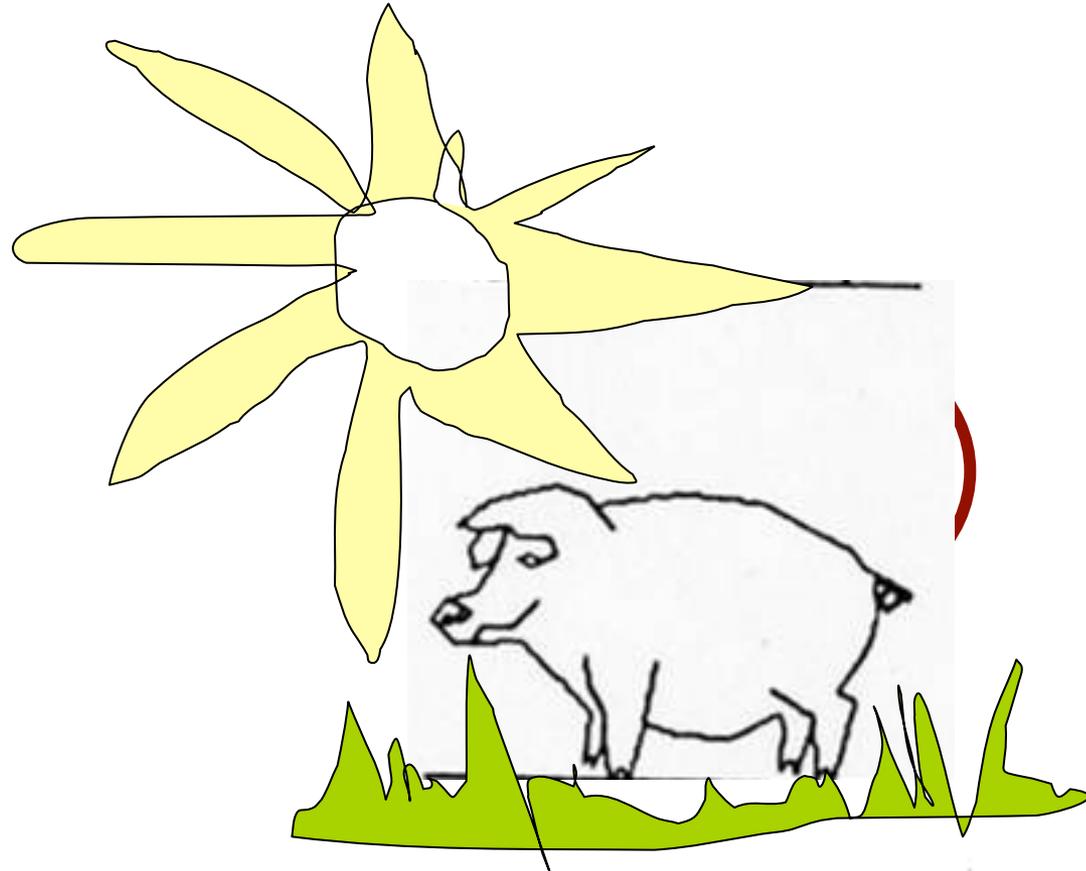
$\ln(y)$: 0.36

y^2 : 0.40

$y+3$: 0.15

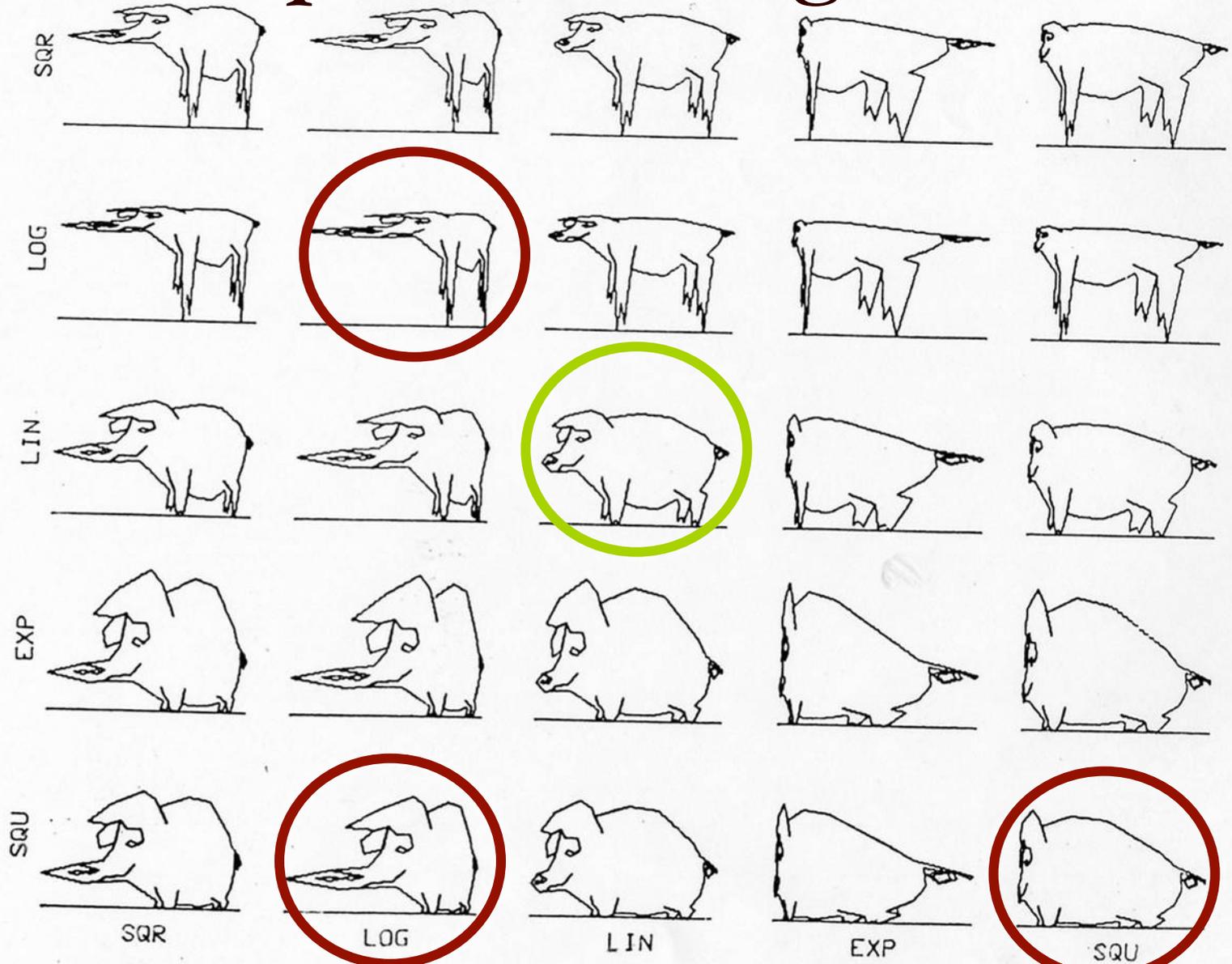
→ **Also, M1 differs among the
monotonic transformations
of matrix y**

Let's say that ordinal data give us a picture of a pig.



What if we transform the data?

The picture changes



Poverty Data

Most non-income poverty indicators are ordinal, binary or categorical.

This affects measurement options (e.g. no normalized gap)

Many previous multidimensional measurement methodologies *required* cardinal data. Hence policy uptake not possible.

Counting measures do not require cardinal data. Why?

By using dichotomised ordinal data, resulting measures are robust to monotonic transformations of underlying data and deprivation cutoffs.

Property of Ordinality (O)

Alkire and Foster, “Evaluating Dimensional and Distributional Contributions to Multidimensional Poverty.” *DRAFT* forthcoming

- **Ordinality (O):** Suppose that $(y';z')$ is obtained from $(y;z)$ as an equivalent representation. Then the methodology $M = (\rho, M)$ satisfies $\rho(y'_i; z') = \rho(y_i; z)$, for all i , and $M(y'; z') = M(y; z)$.
- We say that $(y';z')$ is obtained from $(y;z)$ as an *equivalent representation* if there exist increasing functions $f_j: \mathbb{R}_+ \rightarrow \mathbb{R}_+$ for $j = 1, \dots, d$ such that $y'_{ij} = f_j(y_{ij})$ and $z'_j = f_j(z_j)$ for all $i = 1, \dots, n$. In other words, an equivalent representation assigns a different set of numbers to the same underlying basic data.

How does M_0 move from ordinal to cardinally meaningful data?

Sen (1970, Ch 8): discusses cardinal comparability.

A 0-1 dichotomised ordinal or categorical or cardinal variable is cardinally meaningful (in a trivial sense).

But can it be compared, cardinally, with other dimensions? No.

The 'values' or relative weights create cardinal comparability.