ON THE EFFECTIVE RANGE OF THE ALMOST ONE PARAMETER HYPOTHESIS

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SUMMARY

The almost one parameter hypothesis of the individuality in growth[2] is valid for some somatometric or anthropometric lengths but not for girths nor weight.

It is also valid for the age at the eruption of tooth.

1. Fundamental formulas

Let $y_i(t)$ be the somatometric or anthropometric length, e.g. stature, or length of Femur (with or without epiphyses) of the i -th individual at the age t . Then the hypothesis implies

(a) the following equation

$$y_{ij}(t) = a_{ij} + b_{ij}y_j(t), \quad j = 1, 2,$$

where a_{ij} , b_{ij} and $y_j(t)$ are two constants and the population mean of $y_i(t)$. $j = 1$ and 2 denote the infant and the adolescent periods respectively. We omit the second suffix j when the ambiguity is scarcely possible.

It implies also that

(b) these two coefficients a_i and b_i are highly negatively correlated, so that it is called almost one parametric in each period of the growth.

KEYWORD: Almost one parameter hypothesis; Growth

Then, assuming that the correlation coefficient $\rho(a_i, b_i) = -1$, the standard deviation (SD) of $y_i(t)$ is given by

$$s_y(t) = -s_a + s_b y.(t), \quad \text{for } j = 1,$$

or

$$s_y(t) = +s_a - s_b y.(t), \quad \text{for } j = 2,$$

where s_a and s_b are SD's of a_i and b_i respectively.

These linear relations hold well for

- (i) stature, iliospinal height, tibial height, foot length(with foot-binding effect), and
- (ii) length of a long bone, e.g. Humerus, Radius, Ulna, Femur, Tibia, Fibula, Metacarpal, Proximal phalanx.

The correlation coefficient $P(s_y(t), y.(t))$ is almost $(+1)$ for $j = 1$ and (-1) for $j = 2$. Naturally its value depends largely upon the technical difficulty of its measurement.

2. Roll of epiphyses

Seemingly our basic formula fits better to the length (Z) including epiphyses than that (X) excluding them.

If we set

$$Z = X + Y$$

and assume that X and Y are mutually independent but have the same SD, then there holds the relation

$$s_x(t) = s_z(t)/\sqrt{2}$$

between two SD's. This relation holds well for the range $3 \leq t \leq 12$ in case of male Femur.

3. Dentition

Let Z_α be the α -th tooth and $t_i(Z_\alpha)$ be the age at its eruption of the i -th individual. Then

$$t_i(Z_\alpha) = a_i + b_i t.(Z_\alpha)$$

and consequently

$$s_t(Z_\alpha) = -s_a + s_b t.(Z_\alpha)$$

hold well.

Even though the units of t are different for the deciduous and the permanent teeth, s_b 's are almost the same for these sets of teeth. Note that s_b 's are dimensionless.

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Statures as of 1980 [5]

Eruption of deciduous teeth [7]