Quantitative Genetics Using Human Height Data

This is a set of general guidelines. Use these to analyse the data. Answer the questions that have been asked here. That will be your write-up.

Quantitative Traits: These are traits that show a continuous distribution (rather than the discontinuous distribution of Mendelian Traits). Examples: Height, weight, crop yield, wing length, beak depth etc.

The area of genetics that studies their mode of inheritance is called Q**uantitative Genetics**.

Quantitative traits are typically governed by a large number of loci each of which show Mendelian segregation.

These traits are also affected to varying degrees by environmental effects.

Major question in this experiment: Does height in humans have the potential to evolve?

Separate the data into grand parental, parental and progeny generations.

Step 1: Is there phenotypic variation (Vp) in the population for height?

Plot frequency distribution of heights of males and females in the parental and progeny generation. Calculate the variance in heights for each. (Do you know how to calculate variance?)

Use the graph and the value of the variance calculated to answer the question.

Step 2: Is human height heritable?

For each set of parents and progeny, calculate (a) Mid-parental value (average height of the mother and father) and (b) Average offspring height.

You now have a set of paired values.

<u>Regression 1:</u>

With mid-parent values as X values and Average offspring values as Y values, create a scatter plot.

Fit a linear regression line through these points. **Important; DO NOT constrain it to pass through the origin. Obtain the slope of the regression line.**

The slope of the regression line gives the "narrow sense heritability" ($h^2_{(narrow)}$)of the trait. Heritability varies between 0 and 1. It is defined as the proportion of total Phenotypic variance (Vp) explained by Additive genetic variance (Va).

(Additive genetic component is responsible for the similarity between parent and offspring. This is what selection can act upon. Don't worry, we will learn about this in theory class.)

$h^2_{(narrow)} = Va/Vp$

Calculate the variance of Mid-parent values.

Calculate Va. Call this Va-mid-parent.

Regression 2:

With father's height as X and average offspring values as Y, create a scatter plot.

Fit a linear regression line through these points. **Important; DO NOT constrain it to pass through the origin. Obtain the slope of the regression line.**

Obtain the heritability value from the slope.

Calculate the variance of father's height values.

Calculate Va. Call this Va-father.

Regression 3:

With mother's height as X and average offspring values as Y, create a scatter plot.

Fit a linear regression line through these points. **Important; DO NOT constrain it to pass through the origin. Obtain the slope of the regression line.**

Obtain the heritability value from the slope.

Calculate the variance of mother's height values.

Calculate Va. Call this Va-mother.

Compare the three heritability values and the three Va values. What can you say about these?

Other studies, conducted in other countries, have found heritability values for human heights to be around (0.8). How does your estimate compare with the estimate from these studies? Can heritability of Height be different in different populations? If so, why? If not, why?

Step 3: Is there selection on Heights?

Regression 1:

Create a scatter plot using father's height (or mother's height) as X and number of offspring as Y. Try fitting a linear (or non linear) curve.

What do the curves tell you? Is there a relationship between height and number of progeny? Is the relationship same in males and females? What does this tell you about the evolution of human heights?

Is there some limitation of the data? What if most families had 2 kids? In general, what if there is very little variation in number of kids? What does it tell us about the evolution of heights?

Regression 2:

Create a scatter plot using father's height (or mother's height) as X and time to first reproduction as Y. Try fitting a linear (or non linear) curve.

What do the curves tell you? Is there a relationship between height and time to the birth of first progeny? Is the relationship same in males and females? What does this tell you about the evolution of human heights?

Regression 3:

Create a scatter plot using father's height as X and mother's height as Y. Try fitting a linear (or non linear) curve.

What do the curves tell you? Is there random mating with respect to height in humans? What does this tell you about the evolution of human heights?

General Discussion: What are the potential problems with the data? How would you improve this exercise?