

Prediction of Body-Fat Percentage: A Multiple Regression Analysis

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Introduction

The efficient functionality of the human body depends on the balanced body fat. Currently, there are many expensive and time-consuming techniques available to measure body fat such as air displacement plethysmography and underwater weighing. Body mass index (BMI) is a measure of body fat and is particularly important amongst the medical community because individuals with high BMI are more likely to have health. For example, the American Diabetes Association recommends testing asymptomatic adults for type 2 diabetes if they have any risk factors and a BMI of 25kg/m^2 (23kg/m^2 for Asian Americans) or greater (ADA, 2015) Early detection and treatment of prediabetes has an association of a delayed progression to diabetes (Selph, et.al., 2015). Furthermore, the WHO cites cardiovascular disease, diabetes, musculoskeletal disorders (especially osteoarthritis), and some cancers as common health consequences of raised BMI (WHO).

Currently, BMI is often calculated by measuring an individual's weight and height to obtain a crude result. This can often be a misleading method as it doesn't distinguish between adipose tissue or muscle. As such, many groups have looked to identify other measurements for correlations with BMI and by proxy health outcomes. Measurements like waist circumference, sagittal abdominal diameter, and waist-hip ratio are often correlated with BMI and health outcomes.(Stevens & Truesdale, 2020).

While these measurements are useful, it is worth considering whether other body parts could be measured and used to predict instances of obesity - furthermore, it is worth considering the influence of height and aging on BMI. This project is particularly interested in the measures of neck, density, height, and age. We will be looking at whether or not there is a correlation between any of these variables and BMI. A correlation with any of these measures could offer a simpler or more cost effective method for individuals to predict BMI and by proxy, long-term health outcomes.

Methods

The Body Mass Index (BMI) will be calculated and utilized as an indicator to categorize the body-fat as underweight, overweight, optimal or obese. Body-fat (%) will be categorized as per essential fat, athletes, fitness, Normal and obese. Multiple regression will be used to provide the linear relationship of independent variables such as BMI, Height, Weight, Age, and measurements of different body groups to the body fat percentages. The regression line will be obtained by calculating the coefficients of measurements which are significant predictors to calculate body fat percentage. In this case, the sample size will be utilized to determine the confidence interval of the population mean. Alongside, the regression line will provide a model to predict the body fat percentage.

We will be using a dataset containing measurements of 250 randomly collected men of varying ages to include their age, weight, height, density and dimensions for commonly measured body parts such as neck, waist, hips, chest, and abdomen as well as other less commonly measured body parts like thighs, knees, ankles, biceps, forearms, and wrists (DASL, 2020). All data is provided as an interval data. We will be using a multiple regression model because we are looking to identify the relative influence of multiple variables on BMI. Furthermore, this will enable us to identify anomalous factors and outliers.

Steps:

- Data visualization to check for or validate outliers. Scatter and Box plots are tools that will be adopted to check for outliers
- Outliers will be removed by median imputation.
- An adequate regression model.
- Prediction of body fat percentage

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