Student 1: Low Excellence

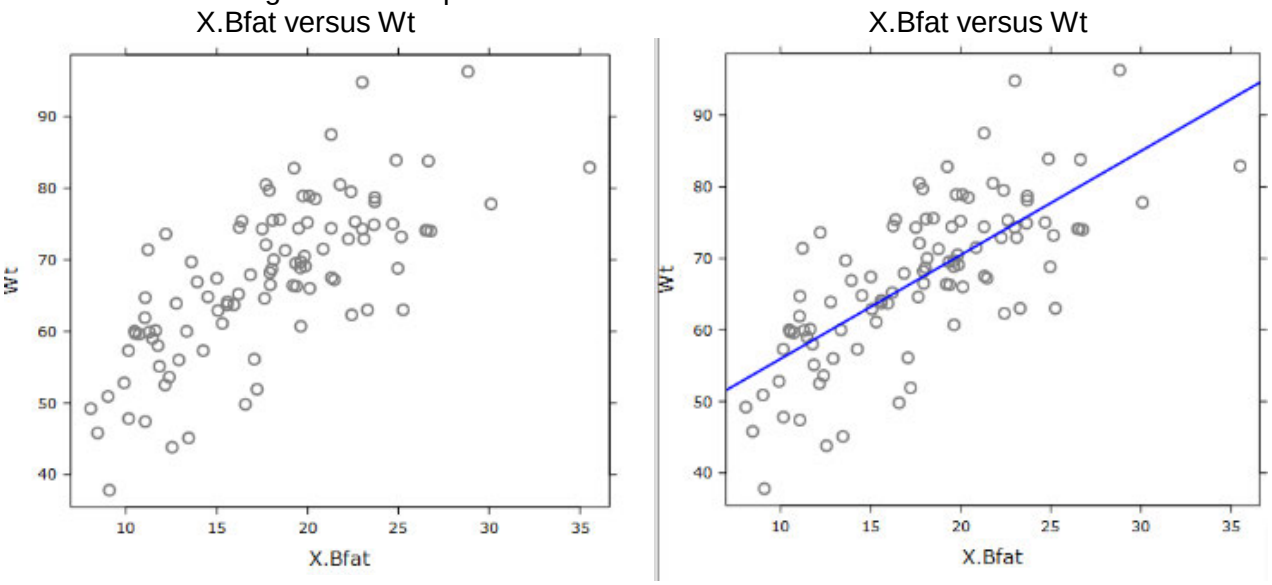
NZQA Intended for teacher use only

Body image is a concern of modern women and just as much for female athletes as it is for other 'normal' women. http://thesportjournal.org/article/body-image-disturbances-ncaa-division-i-and-iii-female-athletes

Weight charts can be unreliable as a source for determining the healthy weight for athletes and body fat percentages are sometimes used instead. Women tend to weigh in the top range for their heights due to muscle mass being heavier than fat mass.

During the 2012 London Olympics the media reportedly criticised some female athletes suggesting that they were fat rather than fit. A list of top female athletes hit back at critics in an article 'Fat? We are fit. Get over it' by Belinda Goldsmith http://sports.yahoo.com/news/fat-fit-over-women-athletes-193539328--spt.html

I am going to investigate if there is a relationship between the weight of a female athlete and their percentage of body fat. I have taken the percentage of body fat as the explanatory variable and the weight as the response variable. (1)



The first scatter graph shows us that there is a positive relationship between the weight of female athletes and their body fat percentage, i.e. people with a higher percentage of body fat tend to be heavier. This is consistent with what we would expect. It also appears to have a linear relationship and there is nothing to suggest that a different model would be better fit to the data. The strength of the relationship is quite strong, as shown by the data points not too far away from the line of best fit in the second graph. (2) (5)

The American Council on Exercise (ACE) divides body fat percentage into five different categories: essential, athletes, fitness, acceptable and obese. Essential body fat ranges from 10 to 14%, athletes 14 to 20% and fitness 21 to 24%. The acceptable range of body fat for women is 25 – 31% and a woman with a body fat percentage of over 32% is considered obese. The percentage of body fat in my scatter graph is mostly between 10 and 26% so this sort of fits what the ACE are saying. There is not much data with a percentage of body fat over 30% but I don't think this means that those in this range won't be athletes more that most athletes in most sports will be under this. There is one value of 35% body fat and looking at the original data this value is for a Netballer. I have looked at the other athletes in the data from the Australian Institute of Sport that have a body fat percentage of more than 25% and 7 of them are netballers and there is one basketball player – this suggests that maybe netballers will be in the higher range of percentage body fat. (3) (4)

Linear model

We see by the trend line that this is indeed a positive relationship - as the percentage of body fat of female athletes increases their weight in kg tends to increase. The gradient of the trend line, Wt= 1.451*%.BFat+41.443, shows us that for every 5% that your body fat increases you can expect to add approximately 8kg to your total weight. The scatter in the graph is consistent across the data set, and most of the data points are close to the regression line indicating that the relationship between percentage body fat and weight of females athletes is strong. 2

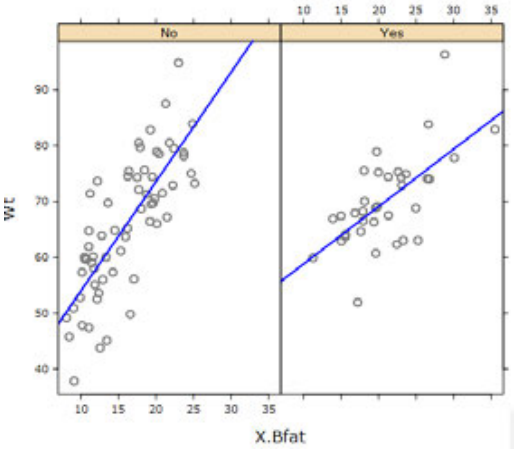
The y-intercept of a weight of around 41kg seems unrealistic as it is impossible to live with 0% body fat as it insulates the body and is your body's energy source. The influence of the y intercept (a body fat % of zero) on the model needs to be considered as while it is possible to have a very low percentage of body fat the essential body fat percentage quoted by ACE is between 10 and 13%. The model that I have found fits the data well and I don't think the body fat percentages in the lower ranges are of interest in my investigation so I will not change the y intercept and look for a new linear model. (It is not possible to have a body fat percentage of 0 and so this part of the model is of little use to us). 3 4

Further investigation

(http://www.livestrong.com/article/510269-what-is-the-normal-body-fat-of-an-athlete/)

The amount of body fat seems to depend on the type of sport in the data supplied from the Australian Institute of Sport for instance shot putters may have more but other sports that involve running and jumping etc. maybe benefit from less. Coaches and trainers have the task of balancing a programme of exercise, training and diet to enable the athletes to perform at their best in their chosen sport and this is likely to involve making decisions about the ideal weight or body fat percentage. I noticed that the some of the athletes with higher percentages of body fat were netballers which suggest that the type of sport that an athlete participates in could change the weight and body fat percentage relationship. For example, athletes who complete in sports that involve throwing a ball could have a higher weight due to a higher percentage of muscle mass but not necessarily have a higher percentage of body fat. For this reason I have re-categorised the data and chosen two subsets, one for sports that involve throwing a ball (netball and basketball) and the other sports which do not. 6

X.Bfat versus Wt Subset by Throwing a Ball



Linear Trend for sports that do not involve throwing a ball

Wt = 1.9565 * %.Bfat + 34.41
Correlation = 0.7797

Linear Trend for sports that do involve throwing a ball

Wt = 1.0288 * %.Bfat + 48.49
Correlation = 0.64753

The different gradients for these lines agree with my research. For those that throw a ball, for every 5% that your body fat increases you can expect to add approximately 10kg to your total weight, but for the non throwing sports it is only 5kg. The strength of the relationship for the sports that do not involve throwing a ball is the stronger. The scatter in this graph looks to be less than the other graph, and the correlation coefficient is stronger. The lower gradient in the ball-throwers graph is consistent with %body fat contributing less to their total weight and them needing a higher % of muscle mass for this type of sport. 5