

Sample
Project 1
+ Punching -

What is the relationship between the characteristics of a person and the speed, pressure of their punch and the number of punches per second?

By Anon

Contents

1. Introduction

2. The Data

1. Box and whisker diagram

2. Scatter graphs

3. Chi-squared test

3. Analysis of Data

4. Conclusions

5. Evaluation

6. Raw Data

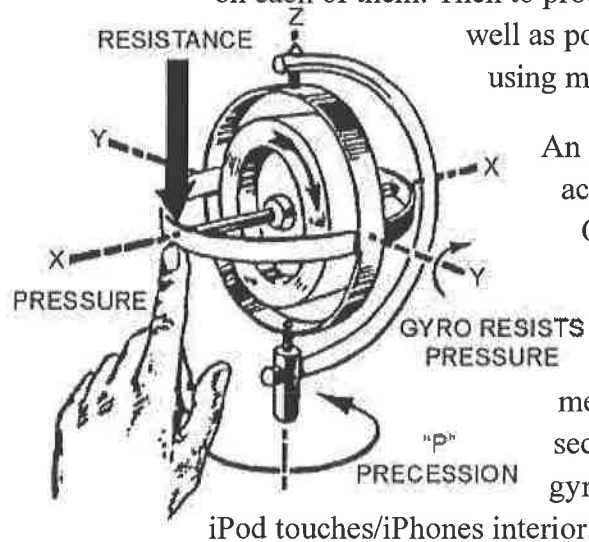
1. Introduction

When applying Mathematics to a particular subject matter, we can often find relationships between two aspects due to the data collected and processed. It is highly relevant as our knowledge expands through our findings. Thus, we can form conjectures with the backup of evidence.

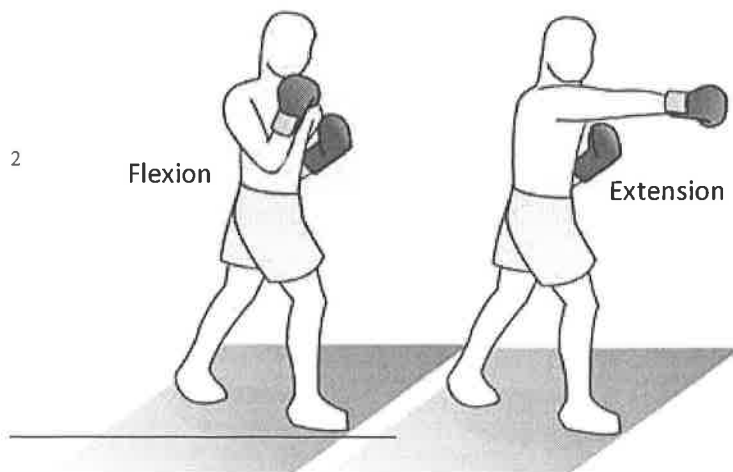
The aim of the investigation is to find whether the weight, age, height, and gender a person affects the maximum speed, number of punches per second and force of their arm? Ones physical characteristics are unique, but can be placed into certain categories in which could be recognized as similar. What is meant by the characteristics of a person? The characteristics in this investigation include the weight, height, age and gender of a person and the length of their arm. This investigation will pursue how these characteristics links with the speed, force, and number of punches per second, using an iPod touch application, punch meter. To find out which

body part or quality of the human body relates mostly to these three processes, a survey will be established and carried out in order to collect the essential data required.

This investigation is intriguing because I have always wondered what made a punch effective and whether these physical aspects affect it. My motivation for this project was that it involved two aspects in which I have skills in, technology and people skills. The technology side of it will involve me finding as many iPod touches as possible and to place a certain application on each of them. Then to product the data, I will have to engage my audience as well as possible to be able to get as many results as possible, using my people skills.



An iPod touch is a portable media player and internet accessible device fashioned and designed by Apple. On this tool there are many different applications available, but only one which I will be using to complete my investigation. This application is called, punch meter. This application involves the measurement of ones speed, force and punches per second in their arm. This is calculated using a gyroscope force also known as an accelerometer in the iPod touches/iPhones interior.



This investigation involves a person punching into thin air, with an iPod touch. From complete flexion to complete extension of the arm, (insuring fairness between each person) the iPod touch will obtain data which I can use to conceive various potential relationships. He/she will punch 3 times in a row as fast as possible for the application

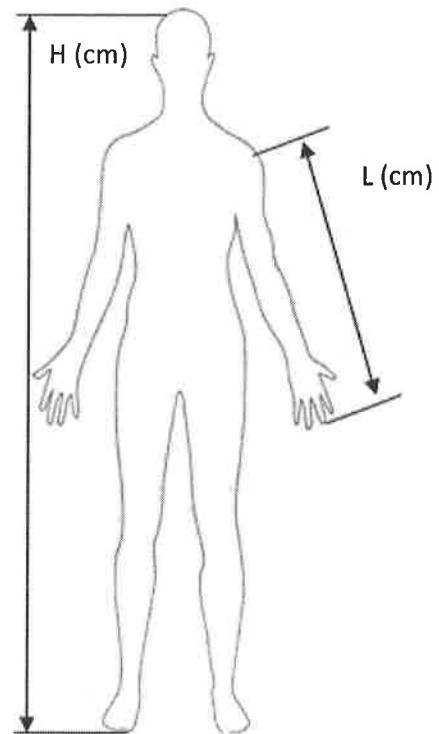
¹ http://www.tpub.com/content/neets/14187/css/14187_137.htm

² http://www.talkboxing.co.uk/guides/boxing_moves.html

to be able to record the appropriate data. In doing this; the application records the average speed, the maximum achievable force and the number of punches per second in which he/she punched.

What do I mean by Speed, maximum achievable force and punches/s? With the use of the accelerometer from the iPod touch, the speed of a punch is determined with the units, km/h from the fastest punch given (during the three punches). The maximum achievable force is the largest force applied by the arm onto the iPod touches accelerometer, which is recorded during the three punches. Their punches/second is established by taking a second and then dividing the time it took for the fastest punch to follow through.

The characteristics I will be taking into account for this project will involve his/her height (H), weight, age, length of an individual arm.(1)



2. The Data

The data I collected consisted of 34 people, in which I measured:

- Height (m)
- Weight (kg)
- Length of an arm (cm)
- Age
- Gender
- Left or right
- Whether they are sportive or not

Weak Hand and Strong hand: (with use of iPod touch application punch meter)

- Speed of punch (km/h)
- Maximum achievable force
- Punches per second

How did I record the data?

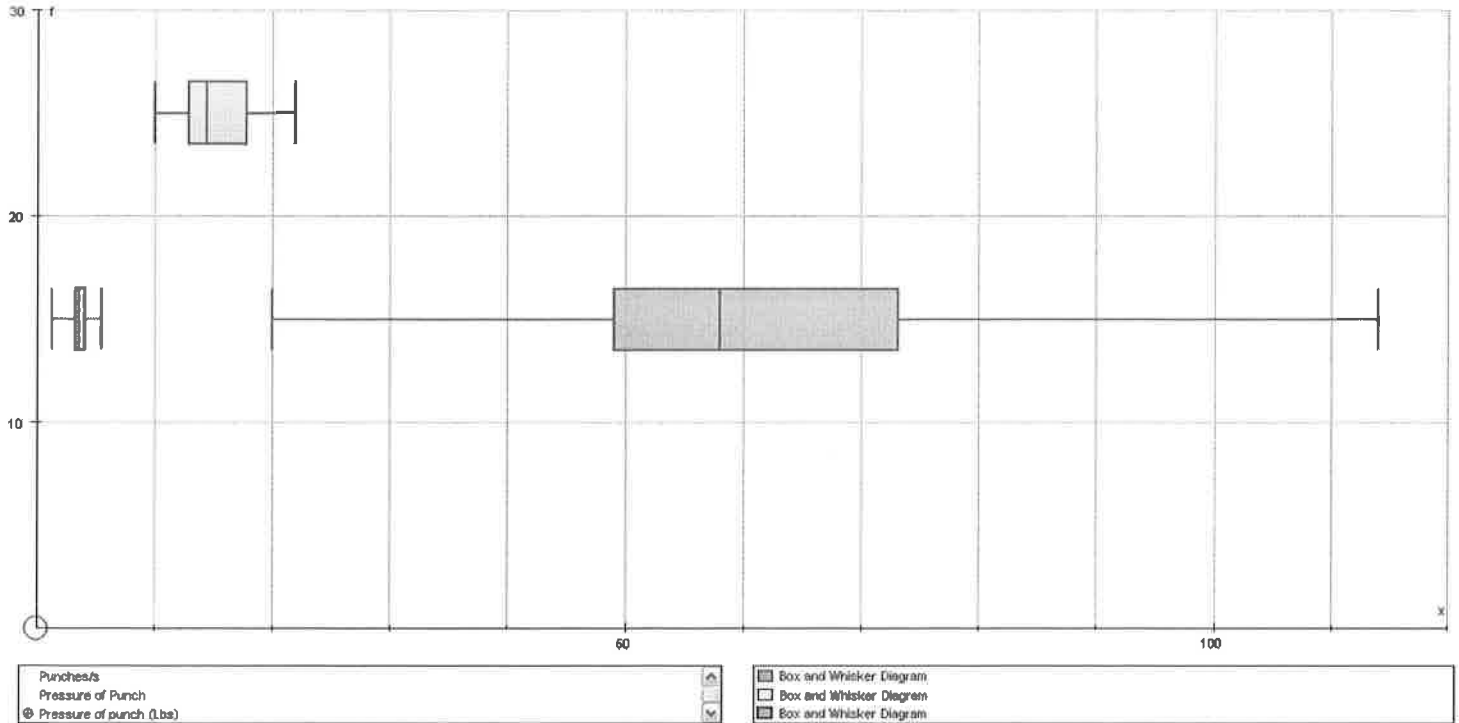
Firstly the process of finding the application to place onto the iPod touch was to find out which application has the most digits. After searching iTunes, through comments and descriptions for the best possible application to use, I found punch meter the most sufficient and appropriate for my investigation. This data was collected primarily, during a break at lunch in school, with help from friends measuring the characteristics of the students, and using 3 different iPod touches to use to record people punches.

In the finding of the data, an online survey was used to record it. The questions used on the survey was basic and simple, this is because no one but me and 2 other friends would be reading them, because we would be interviewing each and every student about their characteristics also using a ruler.

3. Analysis of data.

1. **Box and whisker diagram**
2. **Scatter Graphs**
3. **Chi-Squared Tests**

This is a box and whisker diagram which shows each part of the data collected from the iPod touches application

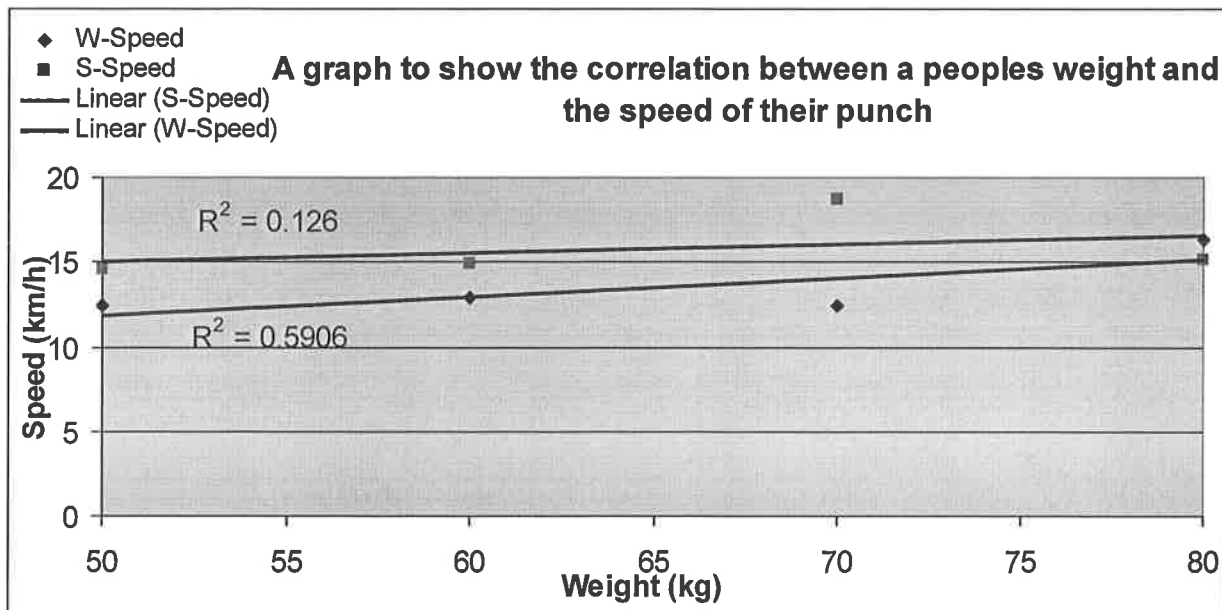


This is a box and whisker diagram which shows each of the aspects of the data obtained from the iPod touch. The yellow box and whisker diagram shows the data for the amount of pressure placed upon the iPod touch during the punches. The orange and whisker diagram shows the number of punches thrown per second and the blue box shows the speed of which the people of my data punched at.

Scatter Graphs

In this next section we will be looking at the speed, number of punches per second and maximum achievable force in relation to the following 4 attributes, weight, height, length of one arm and age.

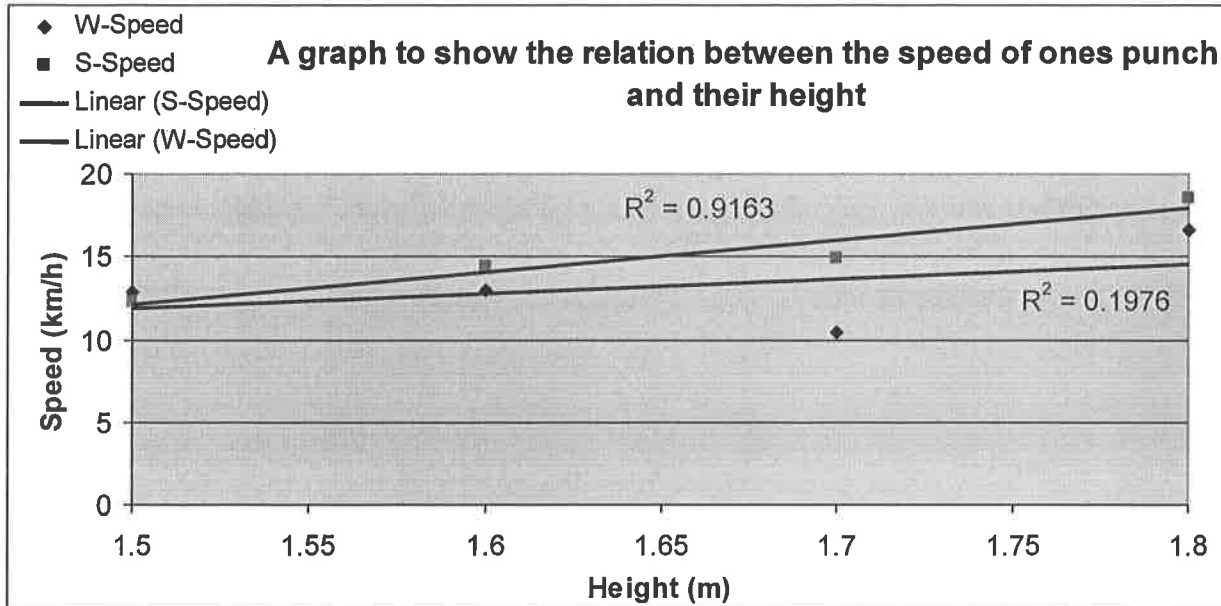
| 1. Speed – Weight | | W-Speed | |
|-------------------|---------|---------|------|
| Weight (kg) | S-Speed | W-Speed | |
| 50 | | 12.4 | 14.6 |
| 60 | | 12.9 | 14.9 |
| 70 | | 12.4 | 18.7 |
| 80 | | 16.3 | 15.1 |



As you can see from this graph the larger ones weight is the more speed one can punch at. But it also shows that after 70 kg it descends maybe to do with overweight as such. There is a significant different between the strong hand and the weak hand, because the weak hand has a really high correlation coefficient, but the strong hand has a very weak correlation. This means that the more weight you have, the faster the throw of your punch is. I believe this is because your weak hand is most likely to be the hand which is least used, therefore the weight that one person is has a particular strength in that hand, and this could change for every different weight, but in people strong hand, people use this hand everyday maybe in sport, driving and even writing therefore that hand is out of proportion with his/her body.

2. Speed – Height

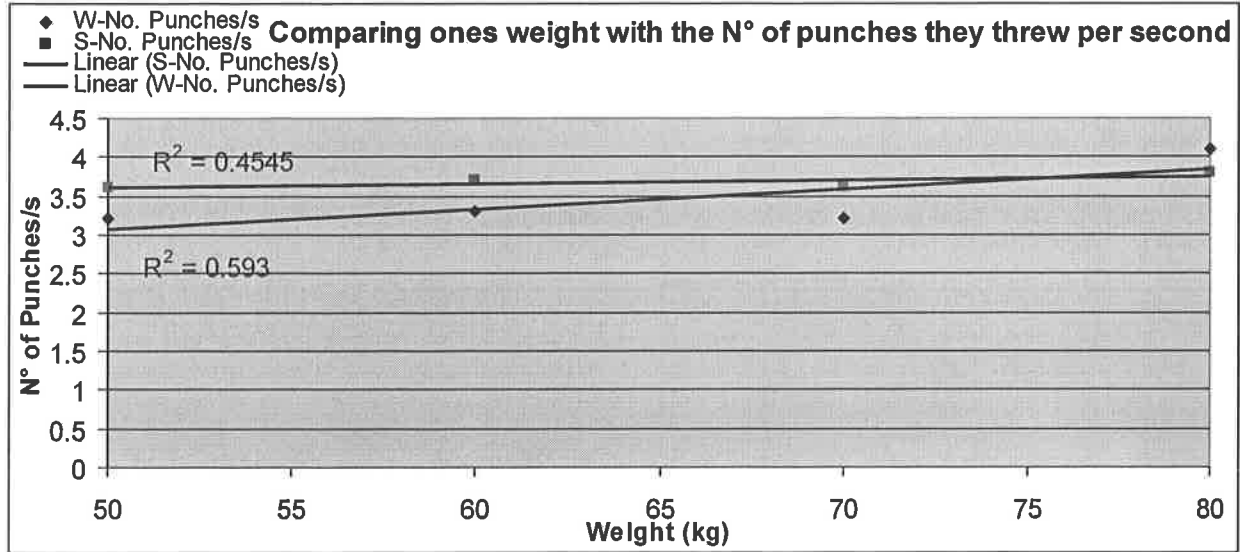
| S-Speed | W-Speed | |
|---------|---------|------|
| 1.5 | 12.8 | 12.3 |
| 1.6 | 13 | 14.4 |
| 1.7 | 10.4 | 14.9 |
| 1.8 | 16.6 | 18.5 |



As you can see here the more height you have the more speed you can throw in your punch. But this time the strong hand has a higher correlation coefficient and also a very strong one. This is another variable which could be further evaluated. Also generally speaking males have more muscle mass than females so here we would expect to see a difference. The left and right handed inclination of individuals is also a variable which could also be further evaluated.

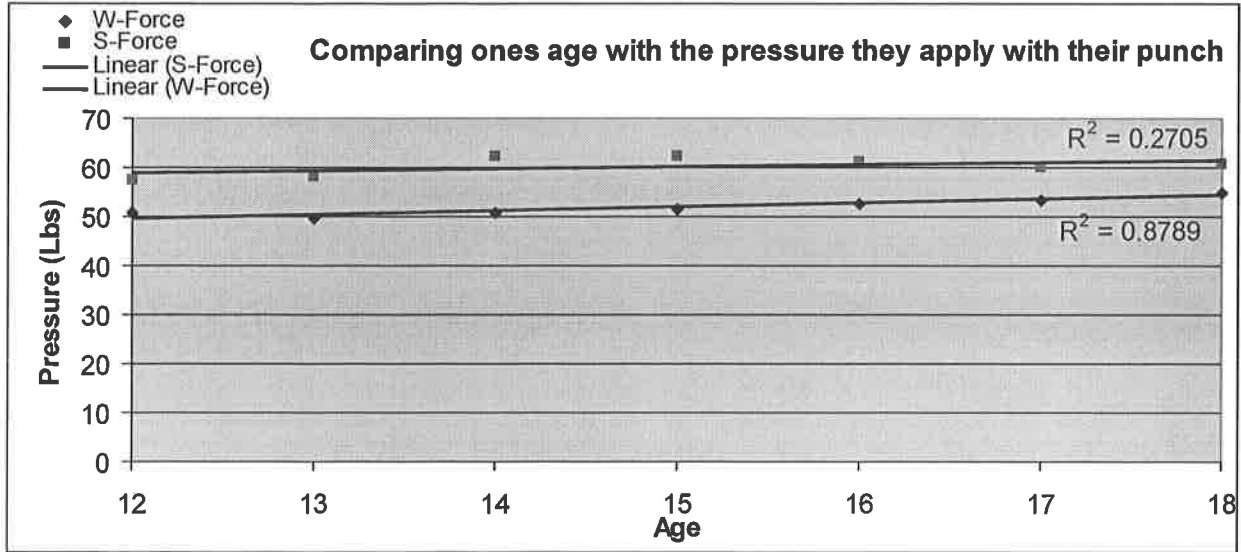
5. N° of punches/S – Weight

| S-No. Punches/s | W-No. Punches/s | Weight (kg) |
|-----------------|-----------------|-------------|
| 50 | 3.2 | 50 |
| 60 | 3.3 | 60 |
| 70 | 3.2 | 70 |
| 80 | 4.1 | 80 |



As you can see on this graph, there are two different correlation coefficients, one for the weak hand and another for the strong hand. The weak hand seems to have more of a correlation than the people's strong hands. I believe that this is because people use their strong hand more different things than how people use their weak hand, so there is more of a correlation between the weak hand than the strong hand because people use their weak hand for more of the same things than what they use their strong hand for, their specialties such as sport... etc.

| Force – Age | S-Force | W-Force |
|-------------|---------|---------|
| 12 | | 50.7 |
| 13 | | 49.8 |
| 14 | | 50.6 |
| 15 | | 51.6 |
| 16 | | 52.7 |
| 17 | | 53.5 |
| 18 | | 55 |
| | 57.3 | |
| | 58.1 | |
| | 62.2 | |
| | 62.3 | |
| | 61.2 | |
| | 59.9 | |
| | 60.8 | |



In this graph we can see that there is a high correlation coefficient with the weak hand but again a weak coefficient with the other, it is an positive trend showing that the older you are the more pressure you apply during your punch.

Chi Squared test

“The chi-square (chi, the Greek letter pronounced "kya") statistic is a nonparametric statistical technique used to determine if a distribution of observed frequencies differs from the theoretical expected frequencies. Chi-square statistics use nominal (categorical) or ordinal level data, thus instead of using means and variances, this test uses frequencies.”³

Null hypothesis – N° Punches/s is independent on gender.

| | Punch/s | |
|--------|---------|--------|
| | WEAK | STRONG |
| MALE | 6.0 | 15 |
| FEMALE | 5 | 7.0 |

| | Observed Frequency | Expended Frequency | Difference (fo-fe) | (fo-fe) ² | (fo-fe) ² /fe |
|---------------|--------------------|--------------------|--------------------|-----------------------------|--------------------------|
| Male Weak | 6 | 7 | -1 | 1 | 0.142857 |
| Male Strong | 15 | 14 | 1 | 1 | 0.071429 |
| Female Weak | 5 | 4 | 1 | 1 | 0.25 |
| Female Strong | 7 | 8 | -1 | 1 | 0.125 |
| | | | | X ² calc value = | 0.589286 |
| | | | | X ² crit value = | 3.841 |

This table consists of results in which I received for the test, the number of punches people threw per second and whether that their gender is dependent on that. Since the calculated value is smaller than the critical value we do not accept the null hypothesis so the number of punches thrown per second is dependent on the gender.

³ <http://cnx.org/content/m13487/latest/>

Null hypothesis – Amount of pressure is independent on gender.

| | Pressure | |
|--------|----------|--------|
| | WEAK | STRONG |
| MALE | 13 | 8 |
| FEMALE | 10 | 2 |

| | Observed Frequency | Expencted Frequency | Difference (fo-fe) | (fo-fe) ² | (fo-fe) ² /fe |
|---------------|--------------------|---------------------|--------------------|--------------------------------|--------------------------|
| Male Weak | 13 | 14.6 | -1.6 | 2.56 | 0.175342 |
| Make Strong | 8 | 6.4 | 1.6 | 2.56 | 0.4 |
| Female Weak | 10 | 8.4 | 1.6 | 2.56 | 0.304762 |
| Female Strong | 2 | 3.4 | -1.4 | 1.96 | 0.576471 |
| | | | | X ² calc value = | 1.456575 |
| | | | | X ² crit value = | 3.841 |

This table consists of results in which I received for the test, the amount of pressure people punch at and whether that their gender is dependent on that. Since the calculated value is smaller than the critical value we do not accept the null hypothesis so the amount of pressure punched per second is dependant on the gender.

Null hypothesis – Speed of punch is independent on gender.

| | Speed | |
|--------|-------|--------|
| | WEAK | STRONG |
| MALE | 6 | 15 |
| FEMALE | 5 | 7 |

| | Observed Frequency | Expented Frequency | Difference (fo-fe) | (fo-fe) ² | (fo-fe) ² /fe |
|---------------|--------------------|--------------------|--------------------|-----------------------------|--------------------------|
| Male Weak | 6 | 7 | -1 | 1 | 0.142857 |
| Make Strong | 15 | 14 | 1 | 1 | 0.071429 |
| Female Weak | 5 | 4 | 1 | 1 | 0.25 |
| Female Strong | 7 | 8 | -1 | 1 | 0.125 |
| | | | | X ² calc value = | 0.589286 |
| | | | | X ² crit value = | 3.841 |

This table consists of results in which I received for the test the speed in which people punched and whether that their gender is dependent on that. Since the calculated value is smaller that the critical value we do not accept the null hypothesis so the number of punches thrown per second is dependant on the gender.

4. Conclusions

To conclude, there is no really good answer on what makes a good punch, but with the three aspect I chose to investigate can be used to show what type of things include in the punch.

Scatter Graphs

Weight speed of punch

The more weight you have, the faster the throw of your punch is. The weak hand has more of a correlation than the strong hand. I believe this is because your weak hand is most likely to be the hand which is least used, therefore the weight that one person is has a particular strength in that hand, and this could change for every different weight, but in people strong hand, people use this hand everyday maybe in sport, driving and even writing therefore that hand is out of proportion with his/her body.

Speed of punch and height

The more height you have the more speed you can throw in your punch. As peoples arm length is also related to their height, it is generally implicit that the taller the person the longer the arms. This would also provide a longer radius for motion around the shoulder and elbow joints to perform the punch motion and movement. What is also important to note maybe not covered by the assessment is that the iPod whilst measuring the force exerted which can be correlated and compared to the height, weight, arm length etc, is also dependent on muscle mass.

Number of punches and weight

For your weak hand, the older you are the more punches you can throw in a second.

Force and age

In this graph we can see that there is a high correlation coefficient with the weak hand but again a weak coefficient with the other, it is a positive trend showing that the older you are the more pressure you apply during your punch.

Chi squared tests

Gender vs. Punches thrown per second

The number of punches thrown per second is dependant on the gender.

Gender vs. Pressure of punch

The amount of pressure punched per second is dependant on the gender.

Gender vs. Number of punches thrown per second

The number of punches thrown per second is dependant on the gender.

5. Evaluations

In this investigation there were many faults and errors. One of them was that I did not have enough data present which affected all the experiments that took place after the data collection; I should have gained more data by interviewing more people for their characteristics and punch abilities. Another problem was to do with the age gap, my investigation was limited to the ages of 12 to 18 and this really narrowed down the ability of my project being taken seriously because I had older and younger people I would be able to expand on my evaluations of the data. What could have been further evaluated would be Right, left handed, male female, age teenager, 20's 30's etc, body mass index amount of body fat, muscle tissue, sportiveness of individuals and all these aspects of a person could have lead to a much more comprehensive and valid conclusions. Another factor I didn't take into account was the time of day the data was collected at. This data obtained via the iPod touch for peoples abilities in their punch could have alternated through out the whole day, so maybe some people was able to place more energy into their punch than others. Another factor to take into account was the application program itself. Was it reliable? There is not enough information to determine its true validity but according to my calculations, there seems to be correlations, therefore the data collected via this application could not have been absolutely inaccurate.

| Age | Weight (Kg) | Height (cm) | Handed | Female | Length of arm (cm) | Sportive? | Strong Hand | | | Weak Hand | | |
|-----|-------------|-------------|--------|--------|--------------------|-----------|--------------------------|--------------------|----------------------|--------------------------|--------------------|----------------------|
| | | | | | | | Speed of punch (km/hour) | Punches per second | punch pressure (Lbs) | Speed of punch (km/hour) | Punches per second | Max achievable force |
| 12 | 35 | 150 | Right | Male | 61 | No | 14.2 | 3.5 | 56 | 13.3 | 3.3 | 49 |
| 13 | 30 | 150 | Right | Female | 64 | No | 10 | 1.3 | 20 | 3.8 | 2.9 | 40 |
| 12 | 35 | 156 | Left | Male | 67 | Yes | 10.3 | 2.6 | 30 | 8.3 | 2.1 | 19 |
| 12 | 36 | 156 | Right | Male | 57 | Yes | 18.9 | 4.7 | 100 | 15.3 | 3.8 | 65 |
| 12 | 52.0 | 157.0 | Right | Male | 68.0 | Yes | 14.6 | 3.6 | 59.0 | 21.6 | 5.4 | 71.0 |
| 18 | 61 | 158 | Right | Female | 68 | No | 14.8 | 3.7 | 61 | 16.8 | 4.2 | 79 |
| 15 | 55.0 | 160.0 | Right | Male | 68.0 | Yes | 16.6 | 4.1 | 77.0 | 15.5 | 3.8 | 67.0 |
| 16 | 52.0 | 163.0 | Left | Female | 65.0 | No | 10.0 | 2.2 | 60.0 | 3.9 | 3.0 | 40.0 |
| 14 | 50.0 | 165.0 | Right | Female | 67.0 | Yes | 14.1 | 3.5 | 55.0 | 12.6 | 3.1 | 44.0 |
| 14 | 65 | 165 | Right | Male | 70 | Yes | 16.6 | 4.1 | 77 | 17.3 | 4.3 | 83 |
| 17 | 54.0 | 165.0 | Right | Male | 71.0 | No | 14.1 | 3.5 | 55.0 | 13.1 | 3.3 | 48.0 |
| 17 | 55.0 | 165.0 | Right | Male | 71.0 | Yes | 12.7 | 3.2 | 45.0 | 13.1 | 3.3 | 48.0 |
| 17 | 50.0 | 165.0 | Right | Female | 68.0 | Yes | 20.2 | 5.0 | 114.0 | 17.0 | 4.2 | 81.0 |
| 14 | 60 | 165 | Left | Female | 68 | No | 13.4 | 3.3 | 50 | 13 | 3.2 | 47 |
| 12 | 45 | 168 | Right | Male | 73 | Yes | 14.8 | 3.7 | 61 | 12.5 | 3.1 | 43 |
| 15 | 56.0 | 168.0 | Right | Female | 71.0 | Yes | 14.4 | 3.6 | 58.0 | 14.8 | 3.7 | 61.0 |
| 17 | 62 | 169 | Right | Female | 72 | No | 11.5 | 2.9 | 37 | 10.6 | 2.6 | 31 |
| 13 | 43 | 169 | Left | Male | 73 | Yes | 12.6 | 2 | 40 | 10.6 | 2.6 | 31 |
| 17 | 60 | 170 | Right | Female | 72 | No | 14.1 | 3.5 | 55 | 5.4 | 1.3 | 67 |
| 15 | 60 | 171 | Right | Male | 74 | Yes | 15.1 | 3.8 | 64 | 16.3 | 4.1 | 75 |
| 17 | 59.0 | 171.0 | Right | Female | 67.0 | No | 14.6 | 3.6 | 59.0 | 13.6 | 3.4 | 51.0 |
| 17 | 68 | 172 | Right | Female | 70 | No | 15.1 | 3.8 | 64 | 13.9 | 3.4 | 54 |
| 12 | 56.0 | 172.0 | Right | Female | 72.0 | No | 10.2 | 2.5 | 29.0 | 3.4 | 1.0 | 40.0 |
| 16 | 60 | 173 | Right | Male | 72 | Yes | 13.9 | 3.4 | 54 | 13.1 | 3.3 | 48 |
| 16 | 65 | 174 | Right | Male | 75 | No | 11.6 | 2.9 | 38 | 9.4 | 2.3 | 25 |
| 16 | 62 | 175 | Right | Male | 72 | Yes | 19.8 | 4.9 | 110 | 14.6 | 3.6 | 59 |
| 17 | 64 | 175 | Right | Male | 70 | Yes | 13.1 | 3.3 | 48 | 13.1 | 3.3 | 48 |
| 16 | 60 | 178 | Right | Male | 79 | Yes | 22 | 5.5 | 85 | 7.4 | 1.8 | 15 |
| 16 | 70 | 180 | Right | Male | 78 | Yes | 20.9 | 5 | 74 | 17 | 4.2 | 100 |
| 18 | 70 | 181 | Right | Male | 79 | No | 14.4 | 3.6 | 58 | 12.6 | 3.1 | 44 |
| 16 | 75 | 184 | Right | Male | 78 | Yes | 20.9 | 5.2 | 52 | 16.1 | 4 | 73 |
| 17 | 69 | 184 | Right | Male | 78 | Yes | 20.9 | 5.2 | 72 | 19.8 | 4.9 | 90 |
| 18 | 60 | 190 | Left | Male | 75 | No | 19 | 4 | 91 | 18 | 4.3 | 80 |

Possible Scores from Sample Project - The Punching Project

| Name | Project 1 | OLD | | NEW | | |
|--------------|-----------------------------|--------------|--|--------------------------|-------|--|
| Strand | Criterion | Mark | Justification | Criterion | Mark | Justification |
| A | Introduction | 2/2 | Title and description of task and plan are included in the first 2 pages. | As before | 2/3 | There is no detailed plan though. Despite much discussion. |
| B | Information / measurement | 2/3 | The data is structured for use, but is limited in quantity with only 34 people being tested. As such it is judged insufficient in quantity. | As before | 2/3 | The same holds true as before, even with new details. |
| C | Mathematical analysis | 2/5 | Candidate attempts both simple and sophisticated processes. Technically both chi tests are incorrect with 25% of exp frequencies less than 5. As such student gets 2 for attempting sophisticated process. | Mathematical process | 4/5 | Judging the simple processes as correct. Box and Whisker diagrams and Scattergraphs. The attempt at chi ² gets a 4. |
| D | Interpretation of Results | 2/3 | For example, candidate correctly interprets the scattergraph on page 6, despite chi ² tests being incorrectly interpreted. | As before | 2/3 | The comments in conclusions constitute plural. |
| E | Validity | 1/2 | On page 13 student discusses some limitations with the data. | As before | 1/1 | Comments about the age gap |
| F | Structure and communication | 2/3 | Project follows logical order and uses correct notation consistently. Linking commentary and the general flow of the project are not substantial enough to make the project 'read well' | Structure | 2/3 | Same reasons as before |
| G | Commitment | 2 | Students struggles with the subject and worked hard at a first attempt of a project related to music, but wisely chose to abandon it and then worked hard to meet commitments with this one. | Notation and terminology | 2/2 | We might argue that the project is too simple, but the candidate uses the chi ² terminology well. |
| Total | Score | 13/20 | | | 15/20 | |

Your criteria

Read all comments

