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An Investigation on Age and Completion Time of a Cycling RaceIntroduction: It is a well known assumption of society today that as a person ages their aptitude for physical work also decreases. My project will analyze what effect, if any, age has on the completion time of a cyclist. The times will be taken from the reported finish times of the male cyclists who competed in a Union Cycliste Internationale sanctioned race. The specific race is the Classic Loire Atlantique, raced in the 2010 season. The race participant??™s times that I will use will be selected randomly from a single race. The data must be from a single race due to the length of the courses each being different.

I will use thirty-three competitors chosen randomly. The age of the competitor is the independent variable, and the completion time of the race is the dependent variable. To appropriately display this data I will use a graph, with a line of linear regression and Pearson??™s coefficient to determine if a correlation exists between these two variables. Then I will use a chi-squared test to determine if the two variables are dependent or not dependent. To complete this assignment I will be using Microsoft Excel as well as a graphing calculator (TI-84 Plus Silver Edition). Data Collection and Processing: To begin this investigation, I first chose 33 competitors??™ times randomly from the Classic Loire Atlantique race. These times were taken from the Union Cycliste Internationale web site.

This was done by taking all the competitors??™ names, times, and ages from the Union Cycliste Internationale web site and entering them into Microsoft Excel 2007. Then I used the command, in Excel, ???= RAND()???, which gives every player a random number between zero and one. I then sorted the resulting numbers by greatest value to smallest value, and selected the

thirty-three greatest numbers and their corresponding competitor with all of their information for use in the investigation. The next step to completing this experiment was to convert the completion time of the competitors to a basic unit (seconds). The original format was ??? hours: minutes: seconds??? for example the time ??? 4: 32: 43??? would be ??? 4 hours, 32 minutes, and 43 seconds.??? To convert this into time into seconds I multiplied the hours by 3600, the minutes by sixty, and added both the products to the seconds. Using the example above, the final conversion would look like this: 4(3600) +32(60) +43= 16363 secondsThe next step was to plot the data in Excel and find a line of least squares regression.

The formula I used to calculate the least squares regression is shown here below: y ??“ y = (sxy / sx2) (x ??“ x)Where sxy=? xyn- xy and sx2=? x2n-x? The dependent variable (y-axis) for this investigation is completion time, and the independent variable (x-axis) is age. In this investigation the numbers are as following: n= 33? x = 819? y = 507643? xy = 12596413? x2 = 20733So: x=? xn= 81933= 24. 81818182 and y=? yn= 50764333= 15383. 12121Sxy=? xyn- xy= 1259641333-24.

8181818215383. 12121= 381709. 4848-381781. 0991=-71. 6143Sx2=? x2n-x2= 2073333-24. 818181822= 628. 2727273-615. 9421489= 12.

3305784y-y= SxySx2x-x y-15383. 12121=-71. 6143250712. 3305784x-24. 81818182 y-15383. 12121=-5. 807864217(x-24.

81818182) y-15383. 12121=-5. 807864217x+144. 1406301y=-5.

807864217x+15527. 26184The data above was all found using a calculator and then again using Microsoft Excel. Now that there is a least square regression line the scatter plot is complete and can be seen, graphed by Microsoft Excel, below: What this calculation shows is a negative correlation between the variables of age and race completion.

To further test the correlation between these two variables I determined Pearson??™s correlation coefficient. The formula for Pearson??™s correlation coefficient is: r=? xy-nxy ? x2-nx2(? y2-ny2) r= 12596413-3315383. 12121(24.

81818182) 7811244911-33(236640418. 220733-33(615. 9421488r=-2363. 271913 2111110(406.

8826896)r=-2363. 271913 29308. 26018r=-.

0806324331r 2 = . 0065015893Because 0 < r2 < 0. 25 there can be said to be a very weak correlation between the two variables. I then confirmed this value with my calculator. Up to this point I have determined that there is a very weak negative correlation between the two variables of age and race completion time. There is one final to test if the two variables are dependent or independent.

For this test, my null hypothesis (H0) will be that age and race completion time are independent from each other. The alternative hypothesis (H1) will be that age and race completion time are not independent. To determine which hypothesis to accept and which to reject, one must first create a frequency table. The frequency table for this problem is shown below: | | Age

(years)| | | | 19-26| 27-34| Sum| Completion Time (seconds)| 14501-15000| 1| 2| 3| | 15001-15500| 9| 2| 11| | 15501-16000| 13| 6| 19| | Sum| 23| 10| n= 33| The table should be read that of the competitors between 19-26 years of age that finished in a time between 14500-15000 seconds there was one competitor that met both of those criteria. Once the frequency table was completed, I then performed a chi-squared test. The process can be seen here: fo| fe| fo ??“ fe | (fo ??“ fe)2| (fo ??“ fe)2 / fe| 1| 2. 0909090909091| -1.

090909091| 1. 1900826446281| 0. 569169960| 2| 0. 9090909090909| 1. 090909091| 1. 1900826446281| 1. 309090909| 9| 7.

6666666666666| 1. 333333333| 1. 7777777777780| 0. 231884058| 2| 3. 3333333333333| -1. 333333333| 1. 7777777777778| 0. 533333333| 13| 13.

2424242424242| -0. 242424242| 0. 0587695133149| 0. 004437972| 6| 5. 7575757575758| 0. 242424242| 0.

0587695133150| 0. 010207337| | | | Total| 2. 658| This shows that x2= 2. 658. The next step was to calculate the degrees of freedom. The degrees of freedom (df) are calculated by taking the number of rows minus one times the number of columns minus one.

So: df = (rows-1)(columns-1). For this problem the calculation was:(3-1)(2-1) = (2)(1) = 2For two degrees of freedom the significance level and critical values are as follows: Significance Level| Critical Value| 10%| 4. 61| 5%| 5. 99| 1%| 9. 21| The x2 value for the set of data that I tested is far too small to meet any of the critical values, so it is clear the null hypothesis is to be accepted. The variables of age and race completion time are independent

from each other. Analysis and Conclusion: The purpose of calculating the least squares regression line (ax+b), is to determine what the relationship is between the two variables.

The line that resulted from my calculations from this set had a slope of -5. 808x. Because the slope in this investigation is -5. 808x, there can be said to be a negative correlation. There is a major flaw in this investigation, in that only a small range of ages was evaluated.

The range was only 13 years (32 years ??“ 19 years = 13 years). So the results from this investigation can only truly be applied to competitors of this age range. The purpose of Pearson??™s correlation coefficient is to determine the strength of the correlation between two variables.

What this investigation found is that r = -. 081 and so r2 = . 007.

It should be noted, however, that since this value is nearly equal to zero it may be considered to represent no correlation. Meaning that age and completion time of a cycling race have almost no effect on each other. According to the table provided, this value represents a ??? very weak correlation??? . The third test the, chi-squared (or x2 test), determines if the two variables are dependent or independent.

The result of the chi-squared test was a value of 2. 658, which was then tested at a certain level (which, for this investigation, could be 10%, 5%, or 1%) for a certain number of degrees of freedom. I determined that no matter which of the three levels tested at, the chi-squared value is smaller. What this means is that the variables are not dependent.

This finding is in line with the findings of the other two tests. While the two other tests did find that there was some correlation between the two tests, it was an extremely small correlation, which means that the variables are likely independent. Overall, the data shows that the age of a race competitor and their completion time are not closely related.

While the mathematical processes show consistent results, I found several flaws in the design. Firstly, the range of ages is far too small to truly give an accurate sample for the age variable. Second, it came to my attention that, according to the rules of the organization Union Cycliste Internationale, each competitor that reaches the finish line as part of a group receives the same time as the first competitor in that group to cross the finish line. The data is then compromised, because the reported times in my raw data are then not entirely accurate. A more sophisticated design for this same investigation might have used a group of volunteers of a wide range of ages, and had them ride around a specific course and using a stopwatch to record their times. Further study on this topic could be conducted. Perhaps instead of a cycling race variables of age and completion time could be conducted using the medium of a walking event.

The original intent of this investigation was to test the popular opinion that age affects a person??™s aptitude for physical tasks. Perhaps another study could be conducted to determine whether age affects mental aptitude as well. Appendix 1: Random Number| Name| Time (seconds)| Age (years)| xy| x2| y2| 0. 990994618| Arnaud Courteille| 15598| 21| 327558| 243297604| 441| 0.

986972436| Mihael Reihs| 15598| 31| 483538| 243297604| 961| 0.

970912704| Jean Marc-Bideau| 14987| 26| 389662| 224610169| 676| 0.

961731588| Tom Relou| 15219| 23| 350037| 231617961| 529| 0.

950646388| Anthony Delaplace| 15100| 21| 317100| 228010000| 441| 0.

93995621| Yohann Gene| 15219| 29| 441351| 231617961| 841| 0.

919656034| Romain Lemarchand| 15108| 23| 347484| 228251664| 529| 0.

868307198| Nicolas Jouanno| 15598| 23| 358754| 243297604| 529| 0.

863753588| Dimitri Claeys| 15598| 23| 358754| 243297604| 529| 0.

861405517| Florian Saalzinger| 15598| 27| 421146| 243297604| 729| 0.

860118066| Jakob Bering| 15598| 22| 343156| 243297604| 484| 0.

834733604| Pim De Beer| 15598| 23| 358754| 243297604| 529| 0. 8124925| Michal Kwiatkowski| 15119| 20| 302380| 228584161| 400| 0.

799687477| Kasper Jebjerg| 15598| 25| 389950| 243297604| 625| 0.

762254448| Pierrick Fedrigo| 14985| 32| 479520| 224550225| 1024| 0.

72557383| Julien Fouchard| 15598| 24| 374352| 243297604| 576| 0.

698527979| Aketza Pena Iza| 15598| 29| 452342| 243297604| 841| 0.

691887735| Damien Monier| 15079| 28| 422212| 227376241| 784| 0.

672277647| Benoit Jarrier| 15598| 22| 343156| 243297604| 484| 0.

635945955| Timon Seubert| 15145| 23| 348335| 229371025| 529| 0.

634742222| Edardo Gonzalo Ramirez| 15598| 27| 421146| 243297604| 729| 0. 629514185| Guillaume Malle| 15598| 25| 389950| 243297604| 625| 0.

600815667| Mickael Buffaz| 15598| 31| 483538| 243297604| 961| 0.

593686578| Dmitry Kosyakdov| 15105| 24| 362520| 228161025| 576| 0.

584215537| Erwan Teguel| 15598| 19| 296362| 243297604| 361| 0.

569810174| Nicolas Queyranne| 15598| 21| 327558| 243297604| 441| 0.

555852442| Romain Zingle| 15570| 23| 358110| 242424900| 529| 0.

545178541| Renaud Dion| 14985| 32| 479520| 224550225| 1024| 0.

52412369| Vitor Rodrigues| 15100| 24| 362400| 228010000| 576| 0.

523715573| Jarno Gmelich| 15079| 21| 316659| 227376241| 441| 0.

519678122| Sergey Firsano| 15598| 28| 436744| 243297604| 784| 0.

509800039| Nico Keinath| 15079| 23| 346817| 227376241| 529| 0.

506433797| Nicolas Baldo| 15598| 26| 405548| 243297604| 676| Appendix 2: Value| Strength of Correlation| r2= 0| no correlation| 0 < r2 < 0. 25| very weak correlation| 0. 25 ? r2 < 0.

50| weak correlation| 0. 50 ? r2 < 0. 75| moderate correlation| 0. 75 ? r2 < 0. 90| strong correlation| 0. 90 ? r2 < 1| very strong correlation| r2= 1| perfect correlation| References:" Classic Loire Atlantique." Web.

22 Mar 2010. . Pre-Calculus Supplementary Packet 2 Statistics, Nordling/Rhoads, 2009-2010————————————————–[1]. http://www. uci.

ch/templates/UCI/UCI5/layout. aspMenuId= MTYxNw&LangId= 1[2]. Pre-Calculus Supplementary Packet 2 Statistics, Nordling/Rhoards, 2009-2010.[3]. Appendix 2