Internal Assessment

Is there a relationship between on-water and machine speeds in rowing?

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Contents

Statement of the task:

I want to compare erg (rowing machine) and on-water speeds between rowers and determine if there is a positive or negative correlation between the two. I will use these results to establish if a fast speed on the erg is related to a fast on-water speed.

An erg machine is a rowing machine. The name comes from the Latin word Ergo which means body, as it provides a full body workout. Also used in other sports such as cross fit, the erg is notoriously known amongst the global rowing community for its brutal precision in determining the strength and endurance of a rower over a set distance. In this investigation, the Swiss rowers competed at the Swiss championships on the erg (Swiss Indoor Championships) which is over a distance of 2 kilometres, the set distance for national, international and Olympic rowing races.

The on-water tests however display a rower's ability to row in a single skull (one person in a boat on water such as a lake or river). The races are in a single skull, and these on-water tests are used by the Swiss rowing federation to see each rower's ability to perform on-water and on their own. In the Swiss Rowing federation for example, they select the top 20 boys(16-18 years old) to train in their national facilities, in which they later determine who will race in which boat for international competitions. The distance of this on-water test is 6 kilometres, and occurs three times a year.

I have been rowing for three years and I have competed in many national regattas in Switzerland. Throughout our rowing season, these on-water tests and indoor competitions had to be completed to demonstrate our commitment, talent and overall strength to the Swiss rowing community. Consequently, I am interested to see if there is a relation between their erg times and on-water times.

A: Clear introduction and aim.

Plan:

I will be using erg and on-water rowing times uploaded from the Swiss rowing website, see bib. p14, where the name, age and time for each candidate is uploaded every year. I have three on-water results to choose from, as the on-water endurance test occurs three times a year though I will pick the last one as it is the most recent. For my erg results, I took the results from Swiss Indoor Championships for January, 2015.

D: Reflects upon how to select the data.

I have quite a lot of data to work with, with 79 results for the on-water times, from age 16 and above, both male and female, and 207 results for the Swiss indoor championships, from age 16 and above, male and female. Of course I will not use all 286 rowing times, as I will only be selecting rowers who have competed both in the Swiss indoor championships (erg) and long distance test on water. This comes down to a total of 58 rowers, or 58 sets of data.

The erg times will be represented by the x variable and the on-water times will be represented by the y variable.

B: Variables defined.

First, so I can compare two events over different distances, I will convert all my data from minutes and kilometres into kilometres per hour. This way all of my results are comparable. Then I will plot these speeds on a scatter graph to allow me to visually determine if there is a correlation between the erg and on-water speeds. To determine the spread of my data and if there are any anomalies, I will complete a box and whisker plot and complete a test for outliers. If an anomaly is present, I may have to remove it from my data to make it more reliable. Once I have done this, I will use Pearson's Product Moment Correlation Coefficient (r) to justify and determine if a correlation between erg and on-water speeds does exist and how strong this relationship is.

I will then use chi squared test of independence (χ^2) to establish if the two variables are independent or dependent of one another. I will then be able to conclude if there is a relationship between erg and on-water rowing speeds.

A: Reasons given for the techniques used.

Calculating Speed:

First I had to convert my data into kilometres per hour, using the formula $\frac{distance}{time} \times 60$. For example, Frederic Hanselmann had the fastest time for the Men's On-water test. He rowed the 6k on-water race in 23.3 minutes:

E: Not according to the raw data.

Speed= $\frac{distance}{time} \times 60$

Speed= $\frac{6km}{23.3\ minutes} \times 60$

Speed= 0.258333×60

Speed= 15.5 km/h

Using my raw data in Appendix 1, I have converted all the rowing times into kilometres per hour (km/h), and produced Table 1 below to provide the results:

Table 1 : On-water and Erg speeds in (km/h)

On-water (km/h)	Erg (km/h)
15.50	19.26
15.49	19.14
15.31	19.05
14.98	18.72
14.94	18.43
14.93	19.11
14.90	19.35
14.88	18.75
14.87	18.66
14.82	18.49
14.80	19.20
14.78	18.81
14.78	18.49
14.75	17.12
14.68	18.58
14.39	19.02
14.31	18.66
14.31	18.93
14.07	18.84
14.09	16.22

E: The values have not been calculated precisely, however this does not detract from the use of mathematics.

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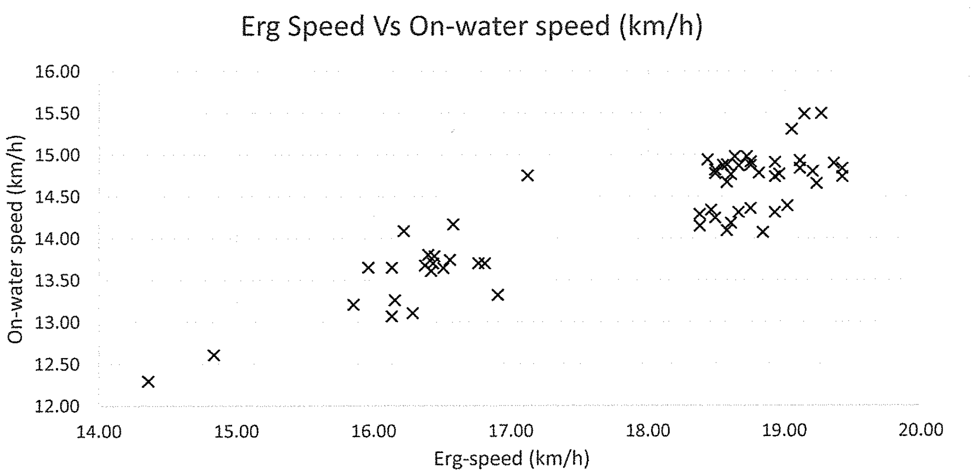
13.80	16.39
13.65	15.96
13.65	16.13
14.98	18.63
14.92	18.75
14.91	18.93
14.88	18.58
14.88	18.55
14.84	19.42
14.84	19.11
14.77	18.96
14.77	18.60
14.74	18.93
14.74	19.42
14.66	19.23
14.36	18.75
14.34	18.46
14.29	18.38
14.25	18.49
14.18	18.60
14.17	16.57
14.15	18.38
14.10	18.58
13.79	16.44
13.70	16.81
13.70	18.43
13.75	16.55
13.70	16.76
13.68	16.37
13.65	16.51
13.61	16.42
13.32	16.90
13.26	16.15
13.21	15.85
13.11	16.28
13.07	16.13
12.61	14.83
12.30	14.35

Now that I am able to compare on-water and erg times, as they are in the same unit, I will plot them on a scatter graph, as seen below in Graph 1. This will allow me to visually interpret the speed of all Swiss rowers on both erg and on-water.

Graph 1: Erg Speed Vs On-water speed (km/h)



I can clearly see a positive relationship between erg speed and on-water speed. As a Swiss rower gets faster on the erg machine, they get faster on-water. However, it seems that there are two groups of rowers that have similar erg speeds, one group being significantly faster than the other. This may be the difference in gender, or the difference in age, yet I do not have enough sets of data from either to individually investigate this further.

D: Reflects upon and interprets the results.

Before continuing, I will first determine if my data has any outliers. To do so, I will calculate the interquartile ranges. I will use the formula $\frac{(n+1)}{4}$ to find the position of Q_1 and $\frac{3(n+1)}{4}$ to find the position of Q_3 amongst my data, where n is the total sets of data.

Position of Q_1: $\frac{(n+1)}{4}$ — Position of Q_3: $\frac{3(n+1)}{4}$

Position of Q_1: $\frac{(58+1)}{4}$ — Position of Q_3: $\frac{3(58+1)}{4}$

Position of Q_1: $\frac{(59)}{4}$ — Position of Q_3: $\frac{177}{4}$

Position of Q_1: 15 — Position of Q_3: 44

Referring to Appendix 2, I ranked my data from slowest to fastest, and establish the value of the 15th and 45th position of both on-water and erg times.

Q_1 = 15th # of On-water speed: 13.70 km/h — Q_3 = 44th # of On-water speed: 14.84 km/h

Q_1 = 15th # of Erg speed: 16.49 km/h — Q_3 = 44th # of Erg speed: 18.93 km/h

I then find the interquartile range using the formula $Q_3 - Q_1$.

On-water IQR= $Q_3 - Q_1$ = 14.84-13.70= 1.14 — Erg IQR= $Q_3 - Q_1$ = 18.93-16.49 = 2.44

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I need the interquartile range to find the upper and lower boundaries, but the quartiles are interesting to me because they allow me to see the spread of my data. To establish the upper and lower boundaries, I use the formulas $Q_3 + (1.5 \times IQR)$ and $Q_1 - (1.5 \times IQR)$.

Upper Boundary = $Q_3 + (1.5 \times IQR)$

Upper Boundary = $14.84 + (1.5 \times 1.14)$

Upper Boundary = $14.84 + (1.71)$

Upper Boundary = 16.55 km/h

Here is a summary, Table 2, of all the results required to draw the box and whiskers graph

Table 2: Interquartile ranges of On-water speed and Erg speed

Interquartile ranges of On-water speed (km/h)	
Minimum	12.30
Q1 Q_1	13.70
Q2 Q_2	14.35
Q3 Q_3	14.84
IQR	1.14
Maximum	15.50
Upper Boundary	16.55
Lower Boundary	12.00
Interquartile ranges of Erg Speed (km/h)	
Minimum	14.35
Q1	16.49
Q2	18.56
Q3	18.93
IQR	2.44
Maximum	19.42
Upper Boundary	22.58
Lower Boundary	12.83

As can be seen in the Table 2 above, all my data falls within the boundaries. The minimum and maximum do not extend outside the upper and lower boundaries, which means that there are no outliers. Checking for outliers allows me to determine if there are any human errors or any systematic errors when the times were being recorded that could affect the reliability of my data. It allows me to determine if they are any values that are not representative of my data. Fortunately, there are no outliers which means that the data I collected is valid and reliable to work with.

I have added Graph 2, labelled Box and Whisker of erg and on-water speed, to visually demonstrate the spread of my data.

D: Reflects upon the validity of the data.

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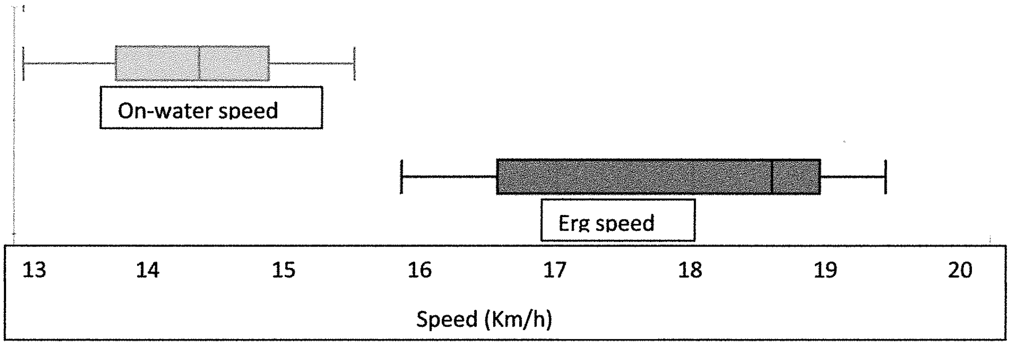
Graph 2: Box and Whisker of erg and on-water speed



Here I can see the spread of the data is normally distributed for the on-water speed, whereas the data is skewed to the left for erg speed. For erg speeds, this means that there is very little variation within the top 50%, but a lot of variation between rowers for the bottom 50%. The interquartile range is also very large in comparison to total range for erg speeds.

D: Interprets the box plots.

I can also see that the slowest erg is faster than the fastest on-water rower. This is because there are more factors that can affect a rower's on-water speed compared to erg speed. As a rower myself, I know that the most impacting factor to have an effect on on-water speed is the technique. A rower can be physically very strong and dominate on the erg machine, yet this superiority in strength can potentially be at the expense of one's technique and slow down a rower on-water. Whilst a rower spends hundreds of hours trying to perfect his technique, there are other factors out of his or her control. Weather conditions like strong winds can slow down a rower, whether directly slowing it down or altering his balance, inhibiting the rower to be able to properly place his oars in the water and push. A rowing machine is stable, the only limiting factor is your strength. Also, all rowing machines used in races are the same, whereas a large percentage of on-water boats have different shapes and set ups which could affect a rower's speed. This is why erg speeds are faster than on-water speeds, because they are far less limiting factors.

C: Some evidence of personal engagement.

Correlation Coefficient:

Now that I know my data has no outliers, I can now calculate the Pearson's Product Moment Correlation Coefficient (r). This will allow me to determine the strength of the correlation between erg speeds and on-water speeds. I will use the following formula to calculate r.

$$r = \frac{\sum xy - n\bar{x}\bar{y}}{\sqrt{\sum x^2 - n\bar{x}^2}\sqrt{\sum y^2 - n\bar{y}^2}}$$

B: Correct notation and variables defined.

I have created Table 3 so that I can find each variable in my formula from my data to calculate r. I will let my erg speed be x and let my on-water speed be y.

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Table 3: r variables

Erg Speed (km/h)	On-water speed (km/h)			
x	y	xy	x^2	y^2
19.26	15.50	298.50	371.01	240.16
19.14	15.49	296.47	366.29	239.96
19.05	15.31	291.55	362.81	234.28
18.72	14.98	280.46	350.47	224.44
18.43	14.94	275.46	339.78	223.32
19.11	14.93	285.32	365.13	222.95
19.35	14.90	288.40	374.61	222.03
18.75	14.88	278.93	351.56	221.30
18.66	14.87	277.51	348.29	221.11
18.49	14.82	274.04	341.88	219.66
19.20	14.80	284.21	368.64	219.12
18.81	14.78	278.08	353.77	218.58
18.49	14.78	273.25	341.88	218.40
17.12	14.75	252.57	293.04	217.68
18.58	14.68	272.62	345.06	215.38
19.02	14.39	273.74	361.66	207.19
18.66	14.31	267.14	348.29	204.89
18.93	14.31	270.93	358.25	204.89
18.84	14.07	265.12	354.88	198.06
16.22	14.09	228.49	262.97	198.53
16.39	13.80	226.29	268.74	190.54
15.96	13.65	217.85	254.64	186.37
16.13	13.65	220.19	260.15	186.37
18.63	14.98	279.15	347.21	224.44
18.75	14.92	279.73	351.56	222.58
18.93	14.91	282.27	358.25	222.40
18.58	14.88	276.45	345.06	221.48
18.55	14.88	275.91	344.00	221.30
19.42	14.84	288.14	377.04	220.20
19.11	14.84	283.55	365.13	220.20
18.96	14.77	280.04	359.38	218.22
18.60	14.77	274.72	346.13	218.04
18.93	14.74	279.03	358.25	217.33
19.42	14.74	286.25	377.04	217.33
19.23	14.66	281.88	369.82	214.86
18.75	14.36	269.25	351.56	206.20
18.46	14.34	264.79	340.83	205.71
18.38	14.29	262.63	337.70	204.24
18.49	14.25	263.41	341.88	202.95
18.60	14.18	263.90	346.13	201.20

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16.57	14.17	234.82	274.72	200.72
18.38	14.15	260.05	337.70	200.25
18.58	14.10	261.84	345.06	198.68
16.44	13.79	226.65	270.22	190.10
16.81	13.70	230.32	282.47	187.80
16.43	13.70	225.15	269.94	187.80
16.55	13.75	227.52	273.96	188.94
16.76	13.70	229.67	280.89	187.80
16.37	13.68	223.92	268.01	187.08
16.51	13.65	225.26	272.45	186.23
16.42	13.61	223.43	269.48	185.25
16.90	13.32	225.19	285.66	177.51
16.15	13.26	214.23	260.85	175.95
15.85	13.21	209.42	251.29	174.53
16.28	13.11	213.46	265.11	171.87
16.13	13.07	210.84	260.15	170.87
14.83	12.61	187.04	220.02	159.00
14.35	12.30	176.48	206.04	151.17

Here are the totals from the Table 3 above.

n	$\sum x$	$\sum y$	$\sum xy$	$\sum x^2$	$\sum y^2$
58	1037.39	828.94	252.56	18654.79	11875.47

Mean of x = $\bar{x} = \frac{\sum x}{n}$

$\bar{x} = \frac{1037.39}{58}$

$\bar{x} = 17.89$

Mean of y = $\bar{y} = \frac{\sum y}{n}$

$\bar{y} = \frac{828.94}{58}$

$\bar{y} = 14.29$

Going back to my formula, I can now fill it in to calculate r.

$$r = \frac{252.56 - (58)(14.29)(17.89)}{\sqrt{11875.47 - (58)(14.29)^2}\sqrt{18654.79 - (58)(17.89)^2}}$$

$$r = 0.88549$$

E: Correct calculation of r.

Using excel, I calculated the r^2 value on my scatter graph so that I could check if my value was correct, as depicted below in Graph 3: Erg Speed Vs On-water speed (km/h).

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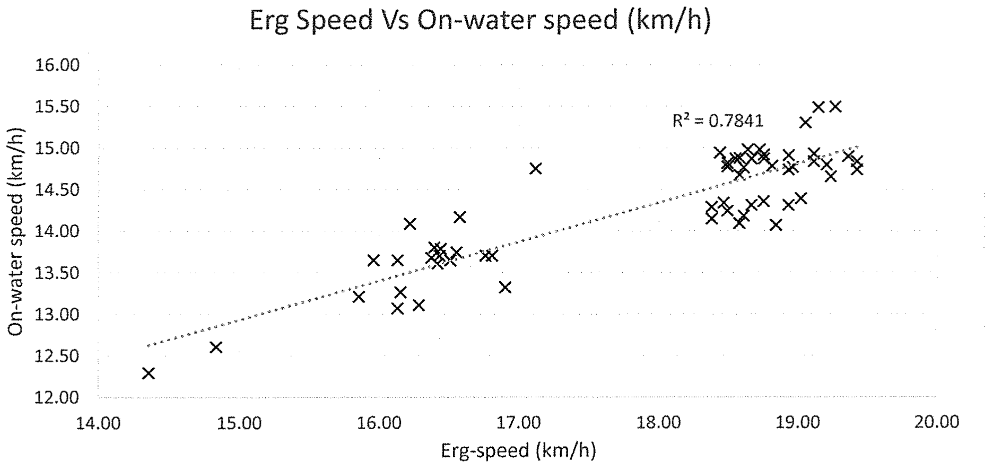
Graph 3: Erg Speed Vs On-water speed (km/h) with regression line



$$\sqrt{0.7841} = 0.88549$$

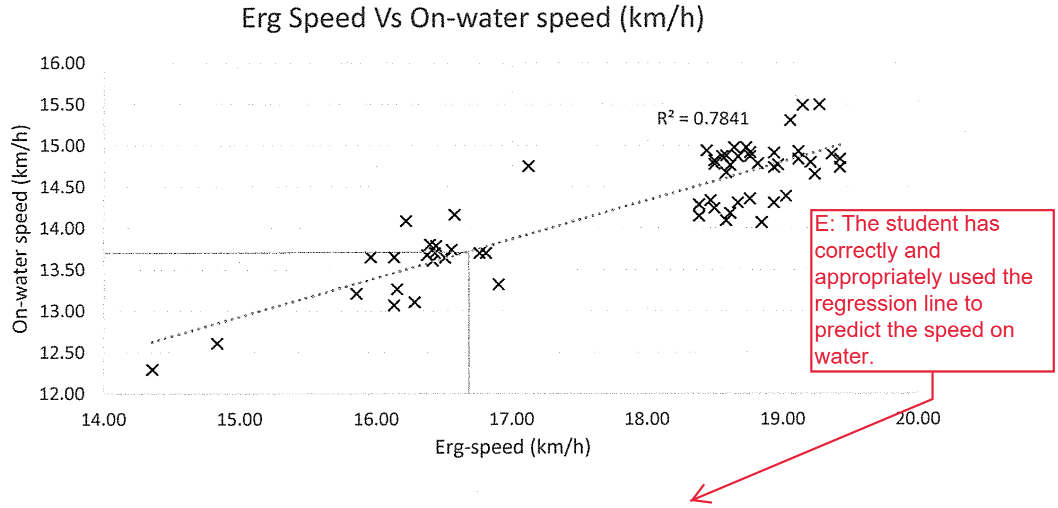
After checking excel to verify that my r value is correct, and with a value 0.88549. I can now conclude that there is a strong positive correlation between on-water rowing speeds and erg speeds.

Using excel, I also plotted a regression line, which can be seen in Graph 3 above.

This will allow me to make predictions about a rower's on-water speed if they only did the erg test. For example, Katharina Strahl did her 2k erg test in 7 minutes and 10 seconds, but she did not partake in the 6k on-water race. By converting her time into speed, I can use it to predict her speed in the on-water race.

Her erg speed was 16.74 km/h. By using the regression line, I can use it to predict Katharina's speed, shown below in Graph 4.

Graph 4: Erg Speed Vs On-water speed (km/h) and predicted speed



Using the regression line, I can predict that Katharina Strahl would be rowing at around 13.75 km/h on-water if she rows the erg test at a speed of 16.74 km/h. Also, I know that my prediction would be fairly accurate because there is a very strong correlation between erg speed and on-water speed.

Chi Squared Test of Independence:

Having determined that there is a strong positive correlation between erg speed and on-water speed, I will use chi squared test of independence (χ^2) to establish if the occurrence of one variable is independent of the other. If my two variables are independent, then I can conclude that the speed on-water does not affect the outcome of the erg speed. Whilst I would like to separately test for dependency between speed and gender and age, I do not have enough data from each age or gender group to do so (for example there are only 12 results for girls under 18 and 4 results for women above 18).

Going back to my chi squared test, I will firstly state my Null and Alternative Hypothesis.

Null Hypothesis: H_0: On-water speed and erg speed are independent.

Alternative Hypothesis: H_1: On-water speed and erg speed are not independent.

Now I will group my data and calculate the Observed (f_o) and Expected Frequencies (f_e).

Table 4: Expected Frequencies

f_o		On-water speed (km/h)					
		12-13.5	13.5-14.0	14.0-14.5	14.5-15.0	15-15.50	Total
Erg speed (km/h)	14-17.0	7	11	2	0	0	20
	17-19.5	0	0	11	24	3	38
	Total	7	11	13	24	3	58

To calculate the Expected Frequencies, I must multiply one group total by another group total, and divide it by the total number of sets.

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For example: $\frac{Erg\ Group\ 1 \times On\text{-}water\ group\ 1}{Total\ number\ of\ sets} = \frac{20 \times 7}{58}$

Table 5: Observed Frequencies

f_e		On-water speed (km/h)				
		12-13.5	13.5-14.0	14.0-14.5	14.5-15.0	15-15.50
Erg speed (km/h)	14-17.0	2.41	3.79	4.48	8.28	1.03
	17-19.5	4.59	7.21	8.52	15.72	1.97

Unfortunately, after calculating the Expected frequencies, more than half of my results are less than 5. Chi squared tests are unreliable if 20% of the expected values are less than 5. However I can improve the reliability of this test by combining groups so no expected cell contains a value less than 5.

E: The student understands that the expected values must be greater than 5.

I have created again a table with the new data groupings.

Table 6: Corrected Expected Frequencies

f_o		On-water speed (km/h)		
		12-14.5	14.5-15.5	Total
Erg speed (km/h)	12-17.0	20	0	20
	17-19.5	11	27	38
	Total	31	27	58

I now reuse the formula I used before to calculate the expected values.

Table 7: Corrected Observed Frequencies

f_e		On-water speed (km/h)		
		12-14.5	14.5-15.5	Total
Erg speed (km/h)	12-17.0	10.69	9.31	20
	17-19.5	20.31	17.69	38
	Total	31	27	58

However, further combining my data into larger groups has consequences. My degrees of freedom are now equal to 1.

$$\text{Degrees of freedom} = v = (\#\ of\ rows - 1)(\#\ of\ columns - 1)$$
$$v = (2-1)(2-1)$$
$$v = 1$$

This means that the normal formula used to determine chi-squared statistics will not work. I must now use Yates's continuity correction factor.

E: The student has understood that Yates correction is needed.

Yates' continuity correction factor

Yates's continuity correction factor is used specifically when the degrees of freedom equal 1. It is used to reduce error in approximation and to improve the validity of my test. This new equation will allow me to determine the calculated χ^2 value:

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$$\chi^2 = \frac{(|f_o - f_e| - 0.5)^2}{f_e}$$

In table 8 below, I used Yates's continuity correction factor to determine the calculated χ^2 value.

Table 8: Calculated χ^2 value

f_o	f_e	$\lvert f_o - f_e \rvert$	$(\lvert f_o - f_e \rvert - 0.5)$	$(\lvert f_o - f_e \rvert - 0.5)^2$	$\frac{(\lvert f_o - f_e \rvert - 0.5)^2}{f_e}$
20	10.69	9.31	8.81	77.62	7.26
0	9.31	9.31	8.81	77.62	8.34
11	20.31	9.31	8.81	77.62	3.82
27	17.69	9.31	8.81	77.62	4.39
					Total = 23.81

Now I know that my calculated χ^2 value is 23.81. I will compare this to the critical value at the 1% significance level. I have picked the 1% significance level because it will leave little margin for error than the 10% significance level, for example. The critical value at 1% significance level is 6.635.

Calculated value: 24.53 > 6.635 = Critical value at 1% significance level

The calculated value is larger than the critical value, which means we reject the null hypothesis.

Thus, on-water speed and erg speed are dependent on one another. This makes sense as ergs are often used as a form of training to help develop a rower's strength and endurance for on-water races. This means that the Swiss Rowing federation is correct to use erg tests to predict a rower's results on-water.

D: interprets and reflects upon results.

Conclusion:

To conclude, my data has a strong, positive correlation, and my variables, erg and on-water speed, are dependent on one another.

The strong positive correlation means that it is reliable for the Swiss Rowing federation to use it to predict a rower's on-water speed with regard to their erg speed. This makes sense because the physical movement is the same so there is not much difference between the two areas in the sport. However, the speed which a rower can attain on an erg cannot be directly transferred on water, as there are other variables that would slow down a rower on-water. Weather conditions, quality of the boat, the temperature of the water, and mostly importantly, technique, all play essential roles on impacting a rower's on-water rowing speed. A rower can be physically very strong and dominate on the erg machine, yet this superiority in strength can potentially be at the expense of one's technique and slow down a rower on-water. This also explains why as a whole, the on-water speeds were slower than the erg speeds.

Due to the fact that my variables are dependent on each other, it is even more beneficial for the Swiss Rowing federation to use erg speeds as a way to predict on-water speeds. If a rower did not compete at one of the on-water races for example, but still participated at the Swiss Indoors erg test, then their result is still very reliable and important for the Swiss federation in determining who the fastest rowers are in the community. This is because ergs are used to train rowers for on-water races,

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as they help build up a rower's strength and endurance. Therefore it would make sense that on-water speeds are dependent on erg speeds.

It would have been very interesting to investigate if there was a correlation between gender and age and one's speed on the erg and on-water. The relationship between a rower's speed and their gender may be obvious due to the agreed, physical superiority in strength that a male has. For example, the qualification erg time for boys to be selected by the Swiss Rowing federation is a whole 1 minute faster than the girl's qualification time. Yet it would be very intriguing to investigate age's effect on a rower's speed in the Swiss rowing community.

There were some limitations to my data however. Over 200 rowers participated in the Swiss indoors, yet only 58 of them also participated in the on-water test. This means that my data is not representative of the entire rowing community. My data is only representative of 29% of the rowing community because not everybody did both the erg and the on-water races. A way to fix this problem would be to use previous on-water tests from 2015 to include more rowers, yet the on-water factors (such as weather conditions, quality of the boat and the temperature of the water) will differ which would affect the validity the data.

D: Reflects upon the limitations of the data used.

To conclude, based on my analysis, given the correlation coefficient of 0.88 and the fact that there is strong dependency between on-water and erg speeds, the erg speed provides a good prediction of the on-water speed and can help the Swiss Rowing Federation to identify fast rowers.

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Appendix:

1.

Rowers	6K On-Water Test (Minutes)	2K Erg Race (Minutes)
Hanselmann Frederic	23:23.25	06:23.2
Ruedi Florin	23:23.88	06:26.9
Barylov Tom	23:51.54	06:29.7
Eichenberger Raèhael	24:03.44	06:41.4
Schaller Aurele	24:09.19	06:51.3
Kuhni Matthias	24:10.82	06:28.3
Morra Alessandra	24:16.24	06:20.7
Gfeller Stven	24:20.29	06:40.3
Streiff Serafin	24:21.43	06:43.5
Buhrer Kaspar	24:29.64	06:49.5
Hirsch Benjamin	24:32.69	06:25.0
Schneider Jan	24:35.03	06:38.6
Studach Severin	24:36.28	06:49.5
Rodewald Tilman	24:40.85	07:01.4
Johner Beat	24:53.40	06:46.7
Hitz Mathias	25:01.59	06:31.4
Loosli Peter	25:15.22	06:43.9
Schorno Alexander	25:15.37	06:34.5
Gulich Lionel	25:58.88	06:37.4
Luscher Amanda	25:55.17	07:40.0
Delacroix pauline	26:08.72	07:32.0
Rodewald Seraina	26:37.33	07:52.8
Holenstein Patricia	26:37.98	07:44.4
Molino Daniel	24:03.86	06:44.1
Fernandez Matthias	24:13.57	06:40.8
Moser Jonathan	24:14.02	06:34.0
Grunig Pablo	24:19.27	06:46.8
Anthonipullai Yassin	24:20.62	06:47.0
Plock Jonah	24:26.52	06:18.5
Schubert Morton	24:26.85	06:28.1
Battistolo Romain	24:37.63	06:33.4
Letta Flurin	24:38.61	06:45.4
Spinas Janic	24:42.33	06:34.6
Ryser Pascal	24:42.76	06:18.0
van de Graaf Hugo	24:56.74	06:24.5
Baerlocher Scott	25:07.59	06:40.0
Kappeli Tim	25:10.86	06:50.3

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Reber Felix	25:19.17	06:53.5
Gutzwiller Merrill	25:27.12	06:49.9
Schmid Jerome	25:38.46	06:45.5
Messmer Luca	25:41.49	07:24.7
Stussi Christian	25:44.63	06:53.0
Zippo Davide	25:54.25	06:46.5
Gebert Joakin	26:11.63	07:30.0
Schaller Justin	26:27.14	07:14.2
Schwark Patrick	26:27.41	06:51.9
v.d Schulenburg Ella	26:19.29	07:25.0
Hofer Debora	26:27.97	07:16.1
Mach Amelie	26:32.17	07:33.2
Merloni Serfina	26:38.56	07:27.6
Conrad Larissa	26:45.20	07:31.2
Strahl Katharina	27:02.52	07:10.5
Schweizer Fabienne	27:14.66	07:43.9
Baumann Nina	27:25.81	07:57.3
Pernet Celia	27:46.61	07:37.1
Meakin Sofia	27:54.15	07:44.7
Melly Marie	28:55.28	08:09.0
Leu Christina	29:28.84	08:36.8
Total Data= 58 Rowers		

2.

Ranking (Slowest to fastest)	Erg (k/h)	On-Water (k/h)
1	14.35	12.30
2	14.83	12.61
3	15.85	13.07
4	15.96	13.11
5	16.13	13.21
6	16.13	13.26
7	16.15	13.32
8	16.22	13.61
9	16.28	13.65
10	16.37	13.65
11	16.39	13.65
12	16.42	13.68
13	16.43	13.70
14	16.44	13.70

15	16.49	13.70
16	16.51	13.75
17	16.55	13.79
18	16.57	13.80
19	16.76	14.07
20	16.81	14.09
21	16.90	14.10
22	17.12	14.15
23	18.38	14.17
24	18.38	14.18
25	18.43	14.25
26	18.46	14.29
27	18.49	14.31
28	18.49	14.31
29	18.55	14.34
30	18.58	14.36
31	18.58	14.39
32	18.58	14.66
33	18.60	14.68
34	18.60	14.74
35	18.63	14.74
36	18.66	14.75
37	18.66	14.77
38	18.72	14.77
39	18.75	14.78
40	18.75	14.78
41	18.75	14.80
42	18.81	14.82
43	18.84	14.84
44	18.93	14.84
45	18.93	14.87
46	18.93	14.88
47	18.96	14.88
48	19.02	14.88
49	19.05	14.90
50	19.11	14.91
51	19.11	14.92
52	19.14	14.93
53	19.20	14.94
54	19.23	14.98
55	19.26	14.98
56	19.35	15.31
57	19.42	15.49
58	19.42	15.50

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