Calories Burned While Running and Walking by C. D. Chester

The American Council on Exercise published and revised their Physical Activity Calorie Counter[1] recently. With this I thought I'd attempt to make some formula accurately representing their data.

The first thing to note is that the calculator factors in weight on a linear scale.[2] The second thing to note is that to accurate get data you must use the 300 lb. and 4h setting on the calculator.[3]

I found that using a Power Regression model was the most accurate.[4] I compared it with a Quadratic, Linear, Exponential, and Inverse Regression Model and this was the only model that fits that narrative of Olympian coaches.[5] ACE's calorie counter only went up to 10 MPH, but mine goes to 23 MPH for the fact of accommodating sprinting.[6] The model yielded this result[7]:

$$CPM \approx \frac{0.887017037(W)[(MPH)^{1.0029229}]}{72}; 5 \leq MPH \leq 23$$

CPM – Calories Burned per Minute

MPH – Running Speed in MPH

W – Weight in lb.'s

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[1] *Physical Activity Calorie Counter* https://www.acefitness.org/education-and-resources/lifestyle/tools-calculators/physical-activity-calorie-counter

[2] For instance, the calculator says you burn 2 times the calories if you weight twice as much. You can generalize to whatever scale you want to.

[3] I say this because the calculator only gives integers back and the linear scaling factor means there may be (there was in many cases) a fractional remainder.

[4] The model achieved 99.6% accuracy.

[5] The faster you run the more calories you burn; thus, it doesn't plateau (Exponential Regression) or reach a peak and drop off (Quadratic Regression).

[6] 23 MPH yields a 100m time of ≈ 9.7s.

[7] Refer to Figure 1 for more data.

Using a similar methodology for walking yielded this[8]:

$$CPM \approx \frac{W[(194568)[(MPH)^2] - (739284)(MPH) + (1276624.8)]}{504}; 2 \leq MPH \leq 5$$

CPM – Calories Burned per Minute

MPH – Walking Speed in MPH

W – Weight in lb.'s

If you are wondering why these formulas "look different" from the regression model guidelines it is that the regression models were for a 300 lb. person doing the exercise for 4h, while this formula yields a generalized version. This is accomplished by dividing the model's output by 72,000.[9] I should note that these formulas are within about 5% of ACE's calorie counter.[10] To conclude, remember that these are estimates, and may vary greatly from the actual calories burned. ACE's calculator just models the average calories burned according to their data, just as I modeled of their data to create my own generalized estimation.

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[8] Refer to Figure 2 for more data. Also, the most accurate model for this problem was Quadratic Regression. It achieved 99.6% accuracy. For extra clarification, no round off was used as the decimals in the regression repeat.

[9] $72000 = 4 \times 60 \times 300$

[10] I tested around 100 numbers, and few reached up to a 4-5% difference from ACE's output.

data

No.	x	y
1	5	4354
2	6	5443
3	7	6259
4	8	7348
5	10	8708

(Inc/Dec of the row)

select: Power regression ▼ $y=Ax^B$

estimate: x ▼ = 7

Execute | Clear | Store/Read | Print | 50dgt ▼

function	value
mean of x	6.9994168124554546630130648831481170938429532232613
mean of y	6,244.0138213168914282968849082115372221561542577 29
correlation coefficient r	0.99596738708497426308526636028366594065460933 0232
A	887.01703651520352785175097161535817617446522468
B	1.0029229081304827298356194355447182228282639381 28
→ estimate of y	6,244.5355898012727673546761109849620285021862697043

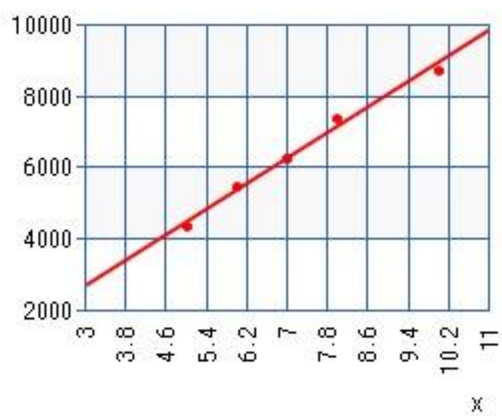

FIGURE 1

data

No.	x	y
1	2	1088
2	3	1796
3	3.5	2068
4	4	2721
5	5	4898

(Inc/Dec of the row)

select: Quadratic regression ▼ $y=A+Bx+Cx^2$

estimate: x ▼ = 3.5

Execute Clear Store/Read Print 50dgt ▼

function	value
mean of x	3.5
mean of y	2,514.2
correlation coefficient r	0.99648331446368770227196845153069501990801295202442
A	2,532.9857142857142857142857142857142857142857142857
B	-1,466.8333333333333333333333333333333333333333333333
C	386.04761904761904761904761904761904761904761904762
→ estimate of y	2,128.1523809523809523809523809523809523809523809524

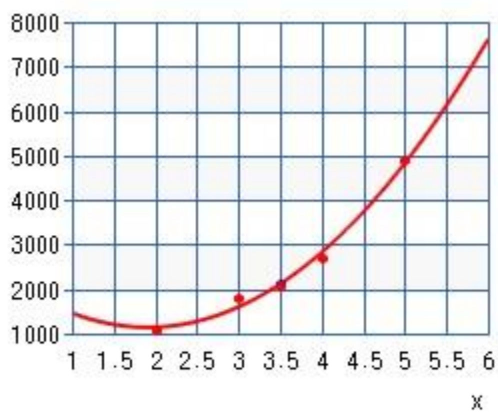

FIGURE 2