

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

The American Council on Exercise published and revised their Physical Activity Calorie Counter<sup>1</sup> 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.<sup>2</sup> The second thing to note is that to accurately get data you must use the 300 lb. and 4h setting on the calculator.<sup>3</sup>

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I found that using a Power Regression model was the most accurate.<sup>4</sup> 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.<sup>5</sup> ACE's calorie counter only went up to 10 MPH, but mine goes to 23 MPH for the fact of accommodating sprinting.<sup>6</sup> The model yielded this result<sup>7</sup>:

$$CPM \approx 0.01232(W)[(MPH)^{1.003}]; 5 \leq MPH \leq 23$$

CPM – Calories Burned per Minute

MPH – Running Speed in MPH

W – Weight in lb.'s

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<sup>1</sup> *Physical Activity Calorie Counter*

<https://www.acefitness.org/education-and-resources/lifestyle/tools-calculators/physical-activity-calorie-counter>

<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> The model achieved 99.6% accuracy.

<sup>5</sup> 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).

<sup>6</sup> 23 MPH yields a 100m time of  $\approx 9.7s$ .

<sup>7</sup> Refer to Figure 1 for more data.

Using a similar methodology for walking yielded this<sup>8</sup>:

$$CPM \approx 0.01W[0.53618(MPH - 1.8991)^2 + 1.5828254]; 2 \leq MPH \leq 5$$

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.<sup>9</sup> I should note that these formulas are within about 5% of ACE’s calorie counter.<sup>10</sup> 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.

<sup>8</sup> 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.

<sup>9</sup>  $72000 = 4 \times 60 \times 300$

<sup>10</sup> 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	6,244.013821316891428296884908211537222156154257729
correlation coefficient r	0.995967387084974263085266360283665940654609330232
A	887.01703651520352785175097161535817617446522468
B	1.002922908130482729835619435544718222828263938128
→ estimate of y	6,244.5355898012727673546761109849620285021862697043

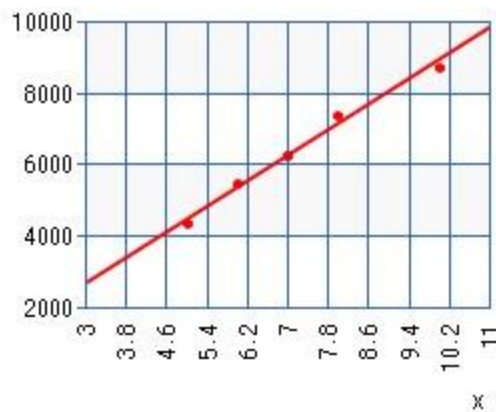


FIGURE 1

