100-Meter Dash Olympic Winning Times:
Will Women Be As Fast As Men?

The 100 Meter Dash has been an Olympic event since its very establishment in 1896(1928 for women). The reigning 100-meter Olympic champion is often named "the fastest man or woman in the world" and as such the event is extremely vital to the competitive nature the Olympics entails. The winning times of men have always been less than those for women, but the discrepancies between the winning times appear to be decreasing. It would be interesting to determine if there are patterns in these winning times, and, if so, use these patterns to predict future winning times and also to predict when the winning time for women would be the same as that for men.

Table 1 below shows the 100 Meter Dash winning times for both men and women. These data are obtained from http://trackandfield.about.com. The 2012 winning time for women was missing from this site and so was obtained from http://bleacherreport.com.

Olympic Winning Times Since 1948

Year	Men's Winning Time(s)	Women's Winning Times(s)
1948	10.3	12.2
1952	10.79	11.67
1956	10.62	11.82
1960	10.32	11.18
1964	10.06	11.49
1968	9.95	11.08
1972	10.14	11.07
1976	10.06	11.08
1980	10.25	11.06
1984	9.99	10.97
1988	9.92	10.54
1992	9.96	10.82
1996	9.84	10.94
2000	9.87	11.12
2004	9.85	10.93
2008	9.69	10.78
2012	9.63	10.75

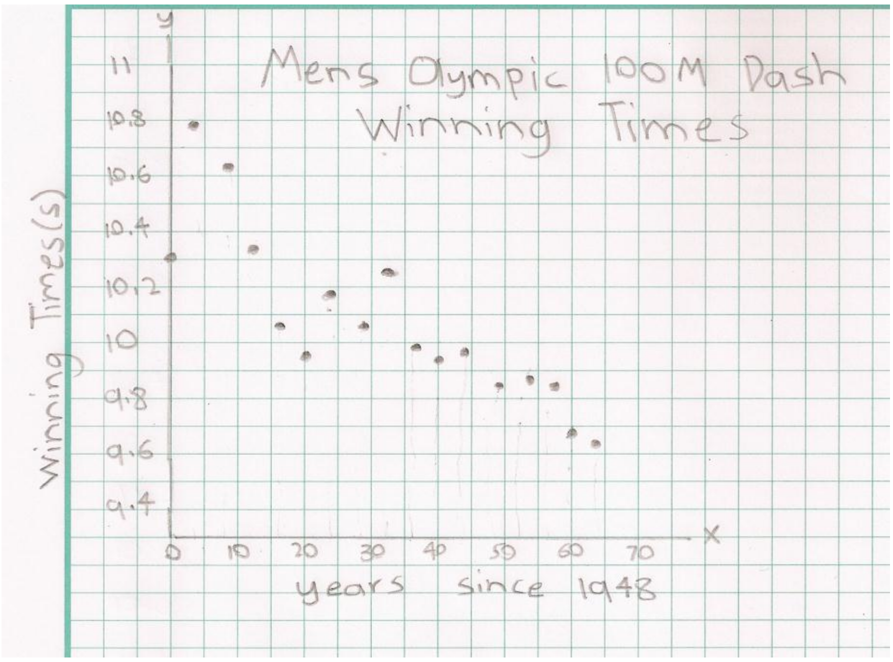
Sources: (1) http://trackandfield.about.com/od/sprintsandrelays/qt/olym100medals.htm
(2) http://trackandfield.about.com/od/sprintsandrelays/qt/olym100women.htm,
(3) http://bleacherreport.com/articles/1285209-olympic-track-2012-100-dash-final-leaves-us-looking-for-gold

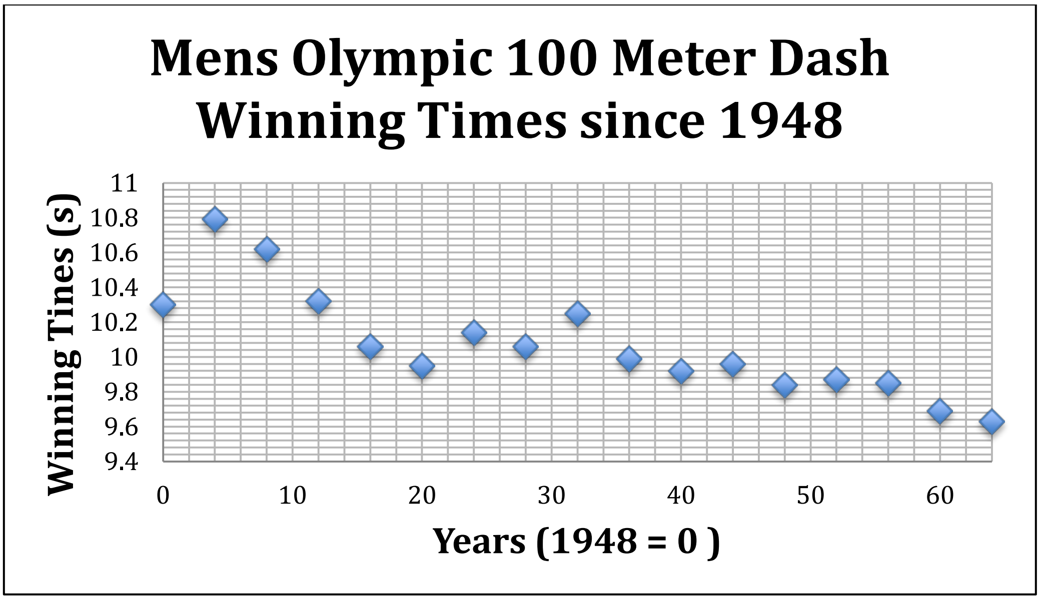
Towards establishing patterns in these data, each year will replaced by the number of years since 1948 so that the numbers become smaller and easier to handle.

Trends in the Men's Winning Times

The men's winning times are shown again in the table on the left below with the years replaced by the numbers of years since 1948. Since the winning times are attained at certain years, it is proper to consider the number of years since 1948 as the independent variable and the winning time as the dependent variable. These variables will correspondingly be represented by symbols *x* and *y*. A hand drawn scatter plot is also presented on the right side, and the technology generated scatter plot, using Microsoft excel, is presented underneath them.

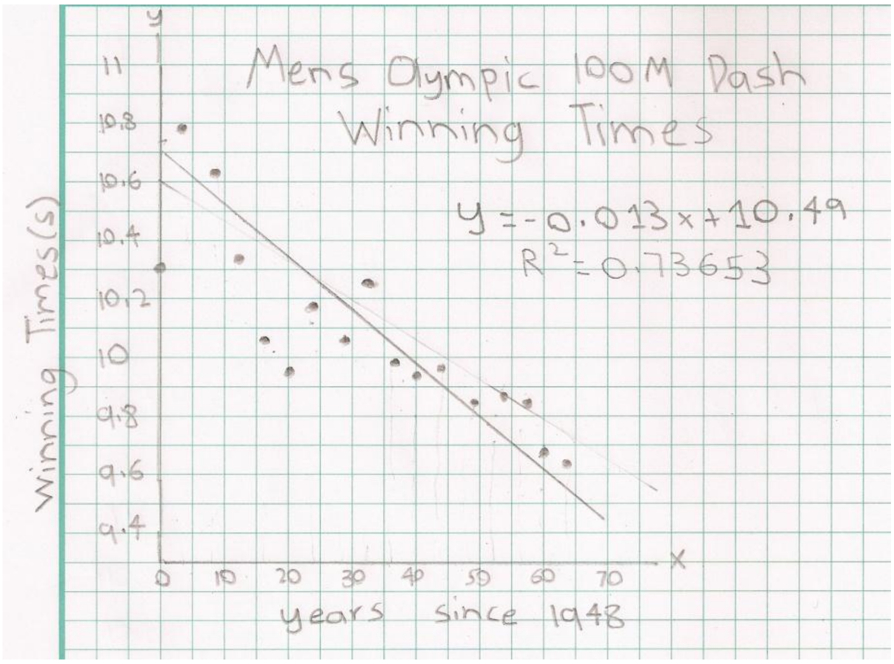
Years since 1948	Winning Time(s)
0	10.3
4	10.79
8	10.62
12	10.32
16	10.06
20	9.95
24	10.14
28	10.06
32	10.25
36	9.99
40	9.92
44	9.96
48	9.84
52	9.87
56	9.85
60	9.69
64	9.63

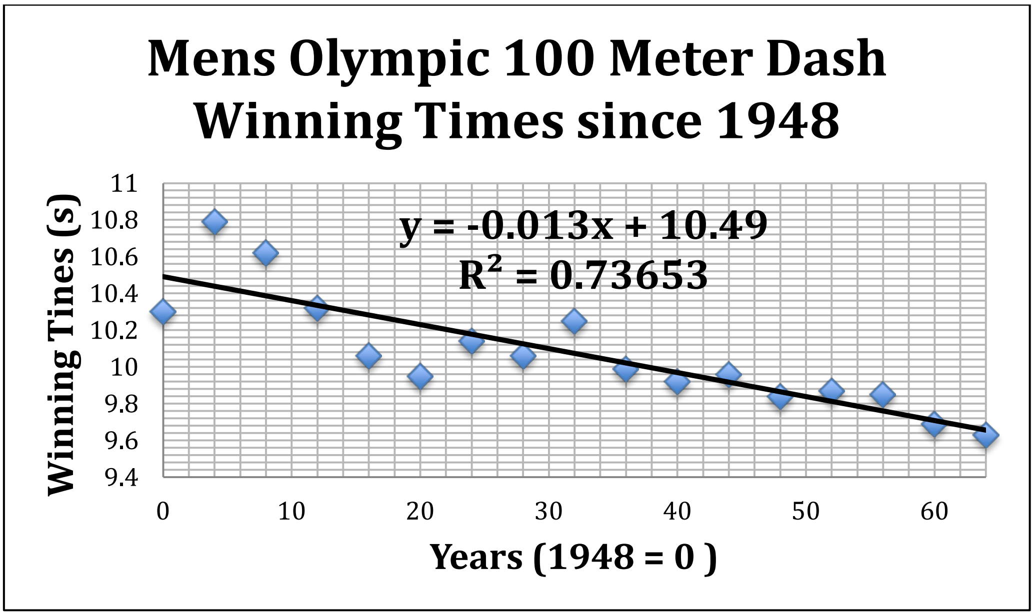




The table and scatter plots clearly indicate that the winning times for men are generally decreasing. There appears to be a linear pattern in the graph; though not all the points fall on a straight line, it seems reasonable to consider a line around which the points cluster. This pattern is more clearly observed in the second half of the data points. If a 'best' such line can be found, then it can provide a good basis for predicting future winning times.

Fortunately, a method called least-squares can find the 'best' line, and Microsoft excel obtains this equation as $y = -0.013x + 10.49$. When drawn on the scatter plots, the following graphs are obtained:





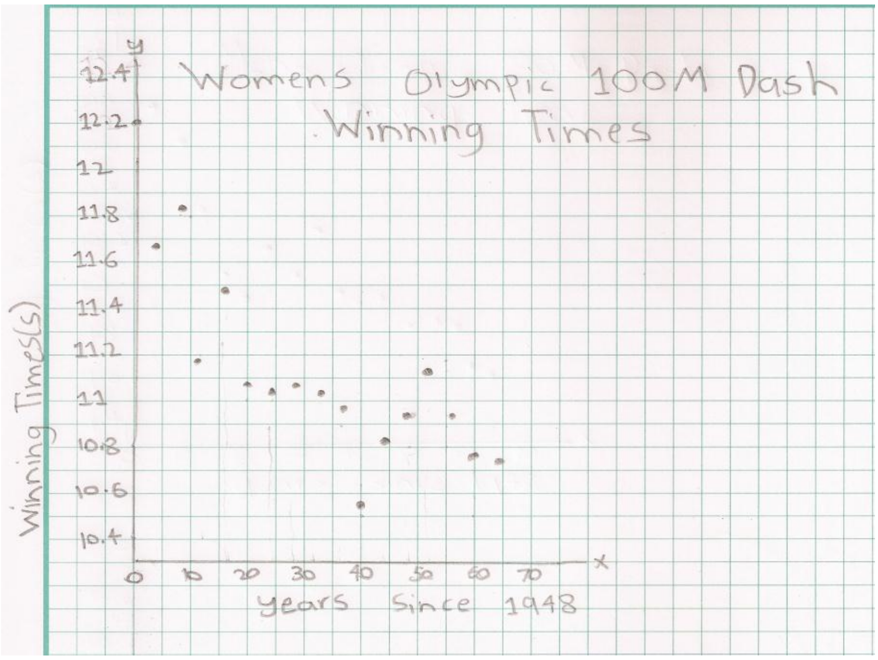
This line has a slope of -0.013 and a y-intercept of 10.49. The slope indicates that there is an average yearly decrease of 0.013 second in the men's winning time from 1948 to 2012. The y-intercept indicates an initial (1948, when x=0) winning time of 10.49 seconds; this is of course not true as the 1948 winning time is 10.3 seconds. But then again this inconsistency is due to the fact that the points do not all fall on the line $y = -0.013x + 10.49$.

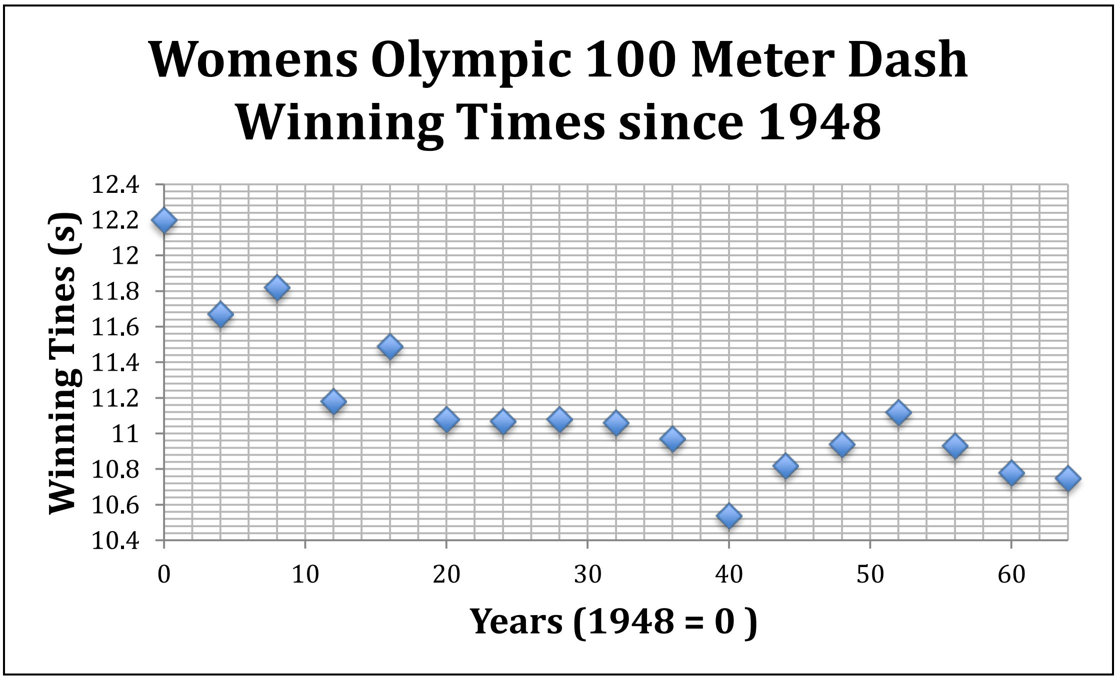
This linear function has a domain of $\{x \in \Re | 0 \le x \le 64\}$. This restricted domain is due to the fact that the 'best' line is only made for the values of x that are used, and the previous table used for the scatter plot shows these values to be from 0 to 64. The corresponding range consists of the y-values covered by the graph for the given domain. Since, for x = 0, $y = -0.013(0) + 10.49 = 10.49$ and, for x=64, $y = -0.013(64) + 10.49 = 9.658$, the range is $\{y \in \Re | 9.658 \le y \le 10.49\}$.

Trends in the Women's Winning Times

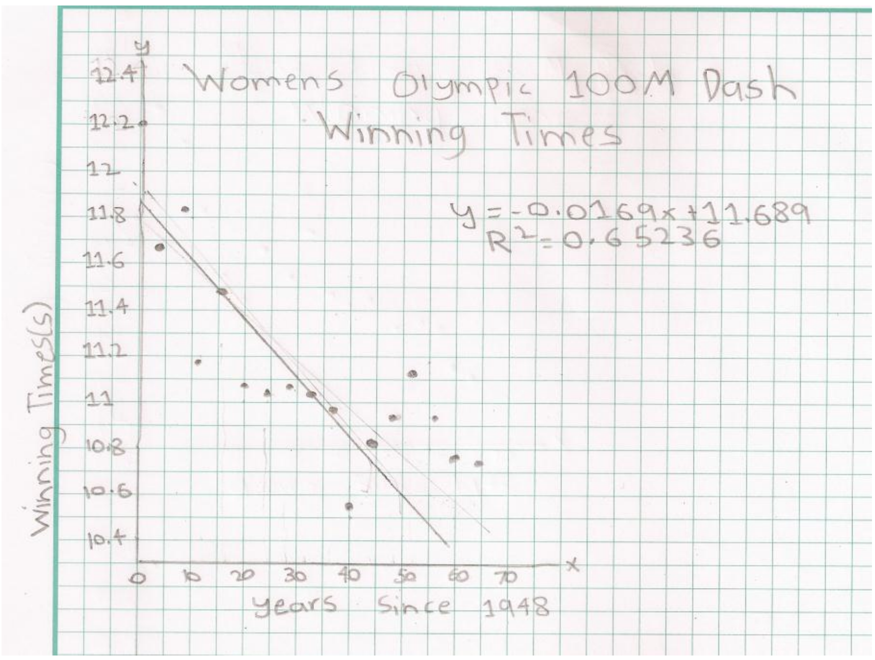
The women's winning times are shown in the table on the left below together with the number of years since 1948. Once again the number of years since 1948 will be the independent variable and the winning time as the dependent variable, and correspondingly represented by symbols *x* and *y*. The hand drawn scatter plot and the technology generated scatter plot are likewise presented.

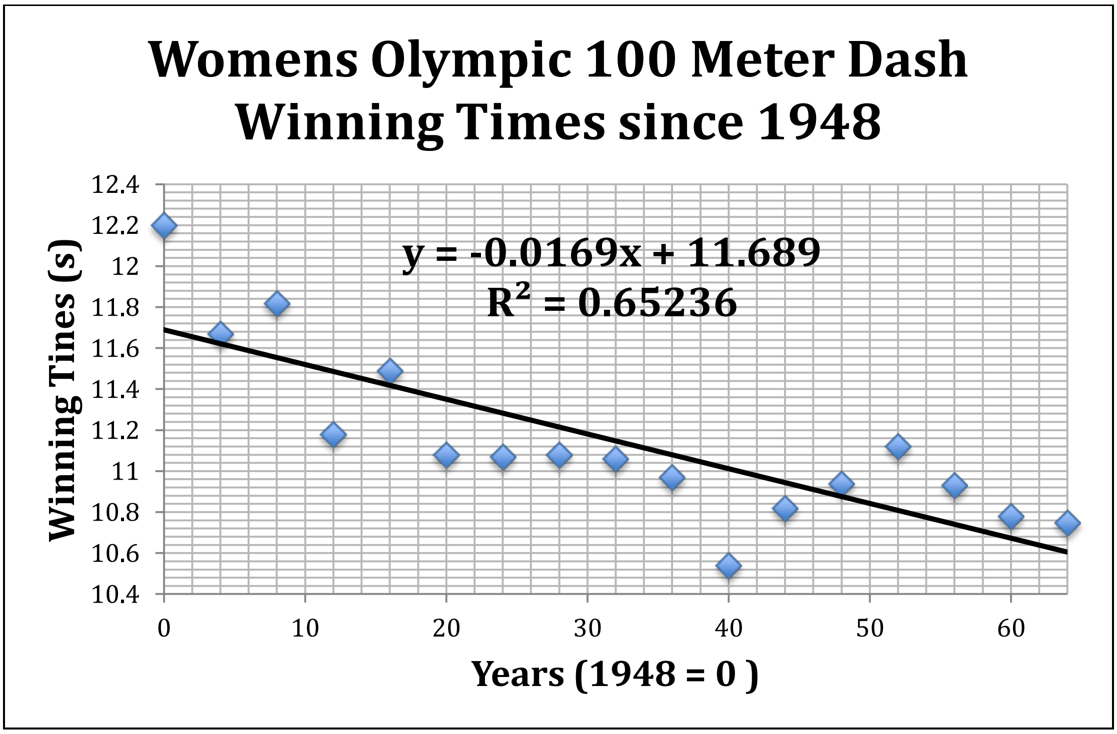
Years since 1948	Winning Times(s)
0	12.2
4	11.67
8	11.82
12	11.18
16	11.49
20	11.08
24	11.07
28	11.08
32	11.06
36	10.97
40	10.54
44	10.82
48	10.94
52	11.12
56	10.93
60	10.78
64	10.75





The winning times for women are also generally decreasing. A straight line pattern also appears to exist, and microsoft excel can again be made to determine the 'best' line through the points. This is found to be $y = -0.0169x + 11.689$. When drawn on the scatter plots, the following graphs are obtained:





The slope of this best line is -0.0169 and the y-intercept is 11.689. As stated earlier, the slope indicates an average annual decrease of 0.0169 second in the women's winning times, and the y-intercept indicates an initial (in 1948, when x = 0) winning time of 11.689 seconds. Of course, the actual winning time of 12.2 seconds in 1948 shows that the 'best' line is in error, but this is once again attributed to the fact that the data points do not all fall on one line so that the 'best' line $y = -0.0169x + 11.689$ can be in error from the actual points.

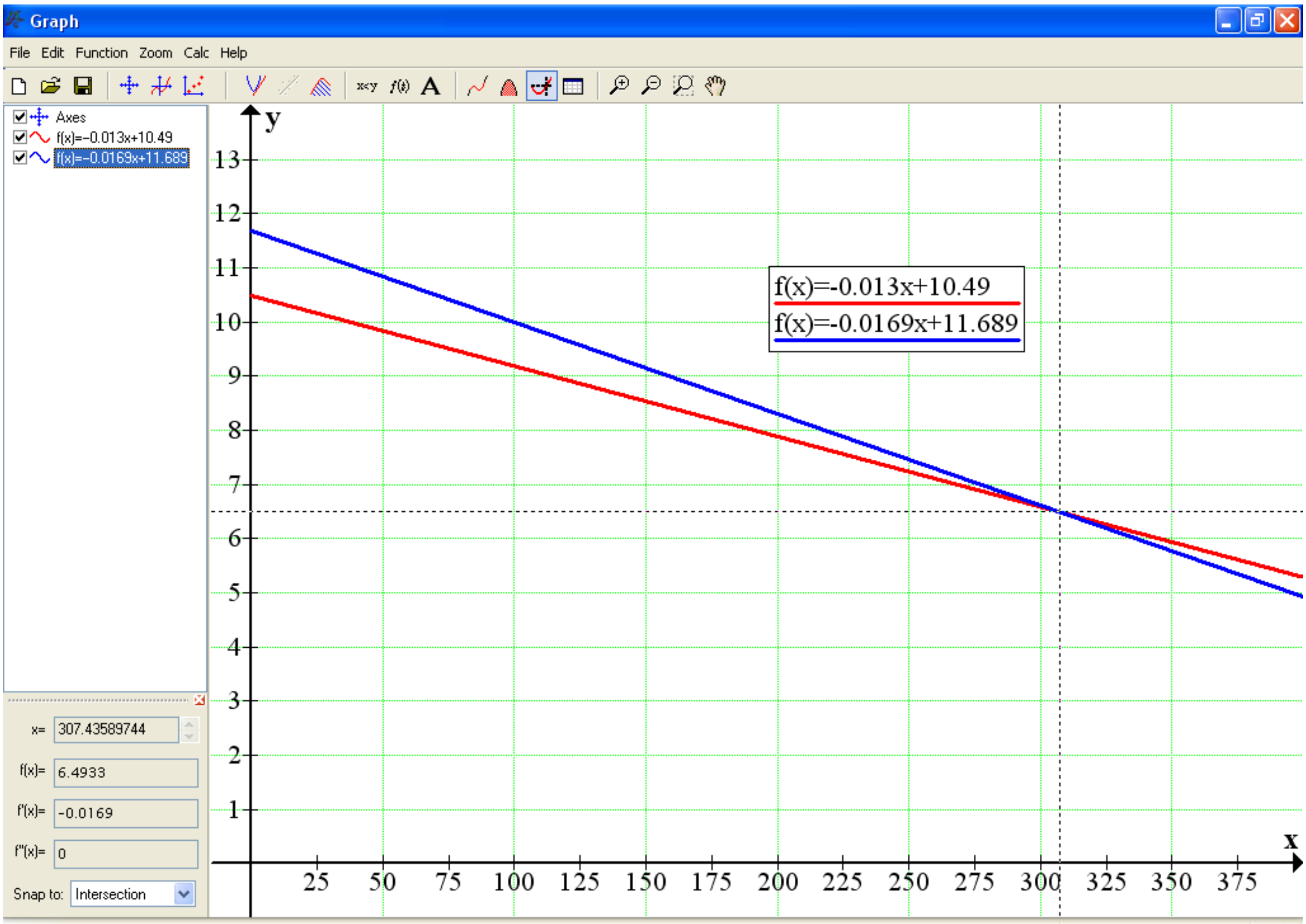
This linear function has a domain of $\{x \in \Re | 0 \le x \le 64\}$. As explained earlier, this is due to the fact that the 'best' line is only made for the values of x that are used. Since, for x = 0, $y = -0.0169(0) + 11.689 = 11.689$ and, for x=64, $y = -0.0169(64) + 11.689 = 10.6074$, the range is $\{y \in \Re | 10.6074 \le y \le 11.689\}$.

Forecasts

With the 2016 Olympics in Rio de Janeiro coming up, the big question is how can these formulae be used to predict the winning times. This is actually simple. Since, in the equations, x represents the number of years since 1948, then, for 2016, x = 2016 – 1948 = 68. Substitute 68 for x in the equations to predict the winning times for 2016.

For the men's winning time: $y = -0.013(68) + 10.49 = 9.606$ seconds
For the women's winning time: $y = -0.0169(68) + 11.689 = 10.5398$ seconds

The men are still predicted to be faster than the women. However, the slopes of the two lines are worth considering. Since women's times are predicted to fall faster (at an average of 0.0169 second each year) than the men's times (at an average of 0.013 second each year), then at some time in the future the winning times will be the same for both men and women. The figure below, using the software Graph 4.4, extends the time frame of the two equations, enough to display the point of intersection of the men's and women's lines. The blue line is for the women's winning times, and the red line is for the men's winning times.



This figure shows that 307.4 years from 1948, or about the year 2255, men's and women's winning times will be the same at 6.49 seconds. After that time, women's winning times are predicted to be less than for the men.

Algebraically, this point of intersection can be obtained by solving the two equations simultaneously. The method of substitution can be used to achieve the result. This is shown below.

$$\begin{cases} y = -0.013x + 10.49 \\ y = -0.0169x + 11.689 \end{cases}$$

$$
\begin{aligned}
-0.013x + 10.49 &= -0.0169x + 11.689 \\
-0.013x + 0.0169x &= 11.689 - 10.49 \\
0.0039x &= 1.199 \\
x &= \frac{1.199}{0.0039} \\
x &= 307.44 \\
y &= -0.013(307.44) + 10.49 \\
&= -4.00 + 10.49 \\
&= 6.49
\end{aligned}
$$

The point of intersection is found algebraically to be (307.44,6.49) which agrees with the coordinates found from the graph.