An expanded tutorial on using map math is available at www.MapTools.com

Map scales grid tools, rulers, and other tools for measuring map coordinates are available

Check with your local map store or visit www.MapTools.com

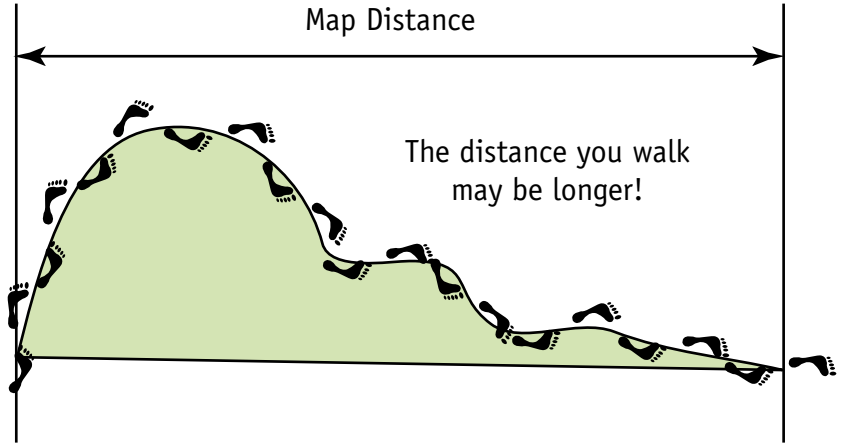
MapTools
1755 La Honda Rd #95
Woodside, CA 94062
www.MapTools.com

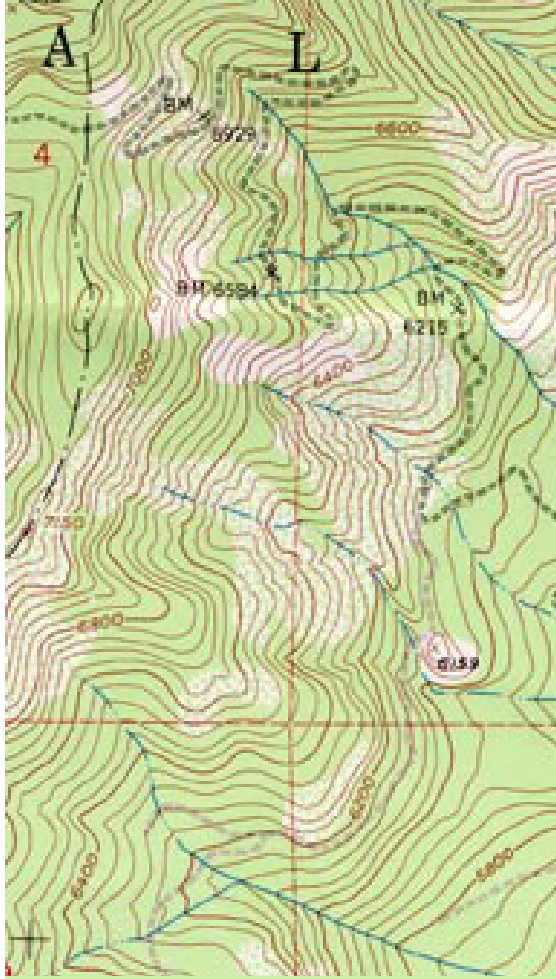
Converting Units

from	to	do this	Examples
milimeters mm	meters m	divide by 1000	1,000mm = 1m 4,321mm = 4.321m
meters m	milimeters mm	multiply by 1000	1m = 1,000mm 4.3m = 4,300mm
meters m	kilometers km	divide by 1000	1,000m = 1km 4,300m = 4.3km
kilometers km	meters m	multiply by 1000	1km = 1,000m 4.3km = 4,300m
inches in.	feet ft.	divide by 12	12 in. = 1 ft. 48 in. = 4 ft.
feet ft.	inches in.	multiply by 12	1 ft. = 12 in. 4 ft. = 48 in.
feet ft.	miles mi.	divide by 5280	5,280 ft. = 1 mi. 7,392 ft. = 1.4 mi.
miles mi.	feet ft.	multiply by 5280	1 mi. = 5,280 ft. 1.4 mi. = 7,392 ft.
inches in.	milimeters mm	multiply by 25.4	1 in. = 25.4mm 12 in. = 305mm
milimeters mm	inches in.	divide by 25.4	25.4mm = 1 in. 305mm = 12 in.
miles mi.	kilometers km	multiply by 1.6093	1 mi. = 1.6093km 5 mi. = 8.0465km
kilometers km	miles mi.	divide by 1.6093	1.6093km = 1 mi. 1km = 0.6213 mi.

Map Distance v.s. Terrain Distance

Distances measured on a map assume a flat surface and do not account or the additional distance introduced as you climb up and down over the terrain.





Map Math Instruction Sheet

Map Scale

Map scale is the relationship of distances shown on the map to distances over the ground.

There are four ways to describe map scale:

Scale as a ***ratio***

1:63,360 or 1:24,000

Scale as a ***fraction*** or decimal value

1/63,360 or 0.000015783

Scale as a ***divisor***

63,360

Scale as an ***equivalence***

1 inch ⇔ 1 mile

In a scale ratio the first number represents a distance on the map. The value of one is always used for the map distance.

The second number is the distance over the ground in the same units as measured on the map.

The ratio holds true no mater what units of measure are selected. However, both map and ground distances must be measured in the same units.

Thus on a 1:24,000 scale map...

one inch on the map
is 24,000 inches on the ground.

one foot on the map
is 24,000 feet on the ground.

Scale Equations

When using these equations, the map and ground distance measurements must be in the same units.

Scale Divisor =

Ground Distance / Map Distance

Map Distance =

Ground Distance / Scale Divisor

Ground Distance =

Map Distance X Scale Divisor

It is usually inconvenient to measure the map and ground distances in the same units. Thus we frequently will convert a large number of millimeters into meters or kilometers. We would convert inches into feet or miles. Refer to the back of this sheet for information about converting units.

Some Examples

On a 1:24,000 scale map, you have measured the distance along a trail with your ruler as 57mm. What distance does that represent on the ground?

Ground Distance = Map Distance X Scale Divisor

Ground Distance = 57mm X 24,000

Ground Distance = 1,368,000mm

Convert to meters by dividing by 1000 to get 1,368m

Convert to kilometers by dividing be 1000 to get 1.368km

Convert to miles by dividing by 1.6093 to get 0.85 miles

On a 1:50,000 scale map, how far apart would 1km grid lines be?

1km = 1,000m = 1,000,000mm

Map Distance = Ground Distance / Scale Divisor

Map Distance = 1,000,000mm / 50,000

Map Distance = 20mm

What scale is a map where 1.5 inches ⇔ 1 mile?

First get the units of measure to be the same

1 mile = 5280 feet = 63,360 inches

Scale Divisor = Ground Distance / Map distance

Scale Divisor = 63,360 in. / 1.5 in.

Scale Divisor = 42,240

The map scale is 1:42,240