Mercator Sailings Problems

- Terms:
  - DLo – the difference in two longitudes.
  - L is latitude.
  - DLat or *l* is the difference between two latitudes.
  - Cn or C is the course/course angle. Course angle is the course measured from 0° at the reference direction clockwise or counterclockwise through 90° or 180°. It is labeled with the reference direction as a prefix and the direction of measurement from the reference direction as a suffix. For example, a true course of 330° T would be noted as N 30° W.
  - D is distance in nautical miles.
  - m is the Meridional parts. The actual length of an arc from the equator to a given latitude, given along a longitude/meridian line. The Meridional Parts Table in Bowditch provides this value.
    - m1 – the meridional parts of the point of departure.
    - m2 – the meridional parts of the destination.
- The main Mercator sailing formula needed are:
  - $l = D \cos C$, which can be restated as $D = l \left(\frac{1}{\cos C}\right)$
  - $DLo = m \ tan\, C$
  - $\tan C = \frac{DLo}{m}$

Mercator Sailings Problems

Mercator Latitude and Longitude Problems

MER D1. You depart latitude 40° 42.0’ N, longitude 074° 01.0’ W and steam 3365.6 miles on course 118° T. What is the longitude of your arrival by Mercator Sailing?

Answer: 17° 40.62’ W.

Step 1: Convert standard latitude and longitudes to decimal form:
Departure Location
40° 42.0’ N = 40.70° N
74° 01.0’ W = 74.02° W

Step 2: Determine the Course Angle:
Course = 118° T
Course Angle = S 62° E

Step 3: Determine the Difference of Latitude (*l*) given the known course and distance. Then convert the mileage to arc.

$l = D \cos C$
$l = (3365.6) \cos(62°)$
$l = (3365.6)\ (0.4695)$
$l = 1580.05'$
$l = 1580.05' \div 60 = 26.3342°$

Step 4: Given that the initial course was to the southeast, subtract the Difference of Latitude (*l*) from the initial latitude to determine the arrival latitude.

Departure Latitude: 40.70° N
Difference of Latitude: -26.3342°
Arrival Latitude = 40.70° - 26.3342° = 14.366° = 14° 22.0’ N

Step 5: Use the Meridional Parts Table in Bowditch to obtain the meridional parts (*m1* and *m2*) for the given latitudes.

Latitude 1: 40° 42.0’
Meridional Parts 1: *m1* = 2662.8

Latitude 2: 14° 22.0’
Meridional Parts 2: *m2* = 865.4

Step 6: Determine the difference in meridional parts (*m*).
m1 – *m2* = *m*
2662.8 – 865.4 = *m* = 1797.4

Step 7: Determine the Difference in Longitude (*DLo*). Convert the mileage to arc.

$DLo = m \ \tan C$
$DLo = (1797.4) \ \tan 62°$
$DLo = (1797.4)\ (1.8807)$
$DLo = 3380.42'$
$DLo = 3380.42' \div 60 = 56.34°$

Step 8: Determine the arrival longitude using the Difference of Longitude (*DLo*).

Departure Longitude: 74.017° = 74° 01.0' W
Difference of Longitude: 56.34° = 56° 20.4'
Arrival Longitude = 74.017° - 56.34° = 17.677° = **17° 40.62' W**

Mercator Sailings Problems

Mercator Course and Distance Problems

MER D2. A vessel at latitude 45° 36.0’ N, longitude 011° 36.0 W heads for a destination at latitude 24° 16.0’ N, longitude 073° 52.0’ W. Determine the true course and distance by Mercator sailing.

Answer: 247.2° T, 3299.2 nm.

Step 1: Convert standard latitude and longitudes to decimal form:
Departure Location
45° 36.0’ N = 45.600° N
11° 36.0’ W = 11.600° W
Arrival Location
24° 16.0’ N = 24.267° N
73° 52.0’ W = 73.867° W

Step 2: Determine the Difference of Latitude (*l*). Convert to minutes of arc.
l = 45.600° N - 24.267° N = 21.333°
l = 21.333° × 60 = 1279.98’

Step 3: Determine the Difference in Longitude (*DLo*). Convert to minutes of arc.
DLo = 11.600° W - 73.867° W = 62.267°
DLo = 62.267° × 60 = 3736.02’

Step 4: Use the Meridional Parts Table in Bowditch to obtain the meridional parts (*m1* and *m2*) for the given latitudes.

Latitude 1: 45° 36.0’
Meridional Parts 1: *m1* = 3064.7

Latitude 2: 24° 16.0’
Meridional Parts 2: *m2* = 1492.1

Step 5: Determine the difference in meridional parts (*m*).
m1 – m2 = m
3064.7– 1492.1 = *m* = 1572.6

Step 6: Determine the Course Angle (*C*).

$$DLo = m \tan C$$
$$\tan C = \frac{DLo}{m}$$
$$\tan C = \frac{3736.02'}{1572.6}$$
$$\tan C = 2.3756$$
$$C = \tan^{-1} 2.3756$$
$$C = 67.172$$

Step 7: Determine the actual course steered given the solved course angle. Note that the vessel headed in a SW direction given the initial and final positions. Therefore, the course angle 67.172° is expressed as S 67.172° W. You can round final answers to nearest tenth.

C = S 67.172° W
180° + 67.172° W = **247.172° T = 247.2° T**

Step 8: Determine the distance travelled using the Plane Sailing formula.

$$l = D \cos C$$
$$D = l \left(\frac{1}{\cos C}\right)$$
$$D = (1279.98) \left(\frac{1}{\cos 247.2}\right)$$
$$D = (1279.98) \left(\frac{1}{(0.3875)}\right)$$
$$D = (1279.98)\ (2.5806)$$
$$\boldsymbol{D = 3303.2\ nm}$$