1 Task

Four angles are depicted in Figure 4.5. Angles y_1 and y_2 were derived from differencing among three observed directions. Angle y_3 was derived from an independent set of two directions. Likewise, angle y_4 was derived from yet another independent set of two directions. All directions are considered uncorrelated with standard deviation $\sigma = 10''$. The derived angles are:

$$y_1 = 60°22'15'', \quad y_2 = 75°39'20'', \quad y_3 = 223°58'40'', \quad y_4 = 136°1'30''.$$

Note: The observed directions are uncorrelated, but some of the derived angles are not.

Use the LESS within the model of condition equations to compute the adjusted angles for y_1 and y_2. Also compute their variances.

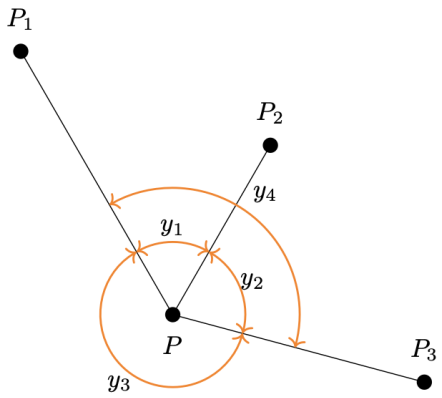


Figure 4.5: Four angles derived from three sets of directions

Figure 1: Enter Caption

2 Task

Four distances were measured between three points A, B, and C as shown in Figure 4.4. The observed distances are:

$$y_1 = 300.013\,\text{m}, \quad y_2 = 300.046\,\text{m}, \quad y_3 = 200.055\,\text{m}, \quad y_4 = 500.152\,\text{m}.$$

There are no correlations between the distances, and their standard deviations are defined by:

$$\sigma = (5 + 10d)\,\text{mm},$$

where d is the measured distance in km. Perform a least-squares adjustment within the model of condition equations to find the adjusted distance between points A and C and its estimated variance.

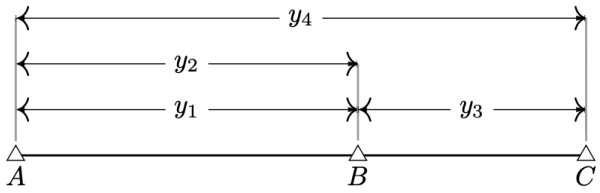
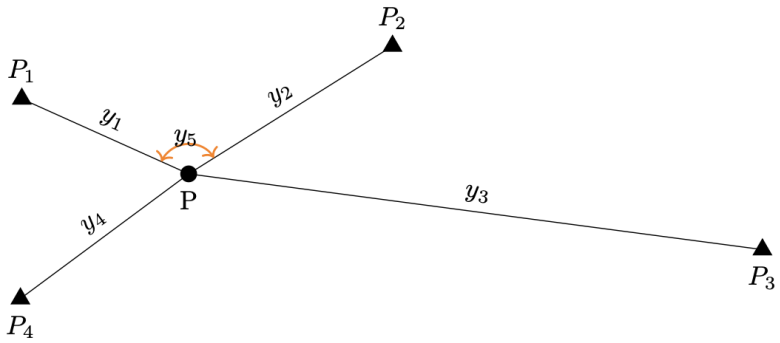


Figure 4.4: Four distances measured between three points A, B, C

Figure 2: Enter Caption

3 Task

To determine the coordinates of a new point P, distances were measured to four given points having known coordinates. One angle was also measured. The coordinates of the given points are listed in Table 3.3, and the observations, along with their standard deviations, are listed in Table 3.4.



Point	P_1	P_2	P_3	P_4
x_i [m]	842.281	925.523	1337.544	996.249
y_i [m]	1831.727	723.962	840.408	658.345

Observations	y_i	σ_i
P_1P	244.457	0.006
P_2P	321.622	0.010
P_3P	773.129	0.024
P_4P	280.019	0.080
$\angle P_1PP_2$	$123°38'20''$	$5''$

4 Task

In order to determine the height of point F, leveling measurements have been taken in forward and reverse directions from three different points A, B, and C, each with known height. The relevant data are given in Table 3.1.

Table 1: Leveling data for Problem 3.

Point	A	B	C
Height [m]	100.055	102.663	95.310
Forward obs. to F [m]	10.064	7.425	14.811
Length of path [km]	2.5	4	6
Reverse obs. from F [m]	-10.074	-7.462	-14.781

5 Task (walkthrough is provided)

Table 4.2 lists distance observations for all sides of a triangle and two of its angles as depicted in Figure 4.2. The standard deviations of the observations are shown in the last column of the table. The observations are to be adjusted by computing the residual vector within the model of condition equations.

Table 4.2: Observations of sides and angles of a triangle

Obs. no.	Observation	Std. dev.
y_1	120.01 m	1 cm
y_2	105.02 m	1 cm
y_3	49.98 m	1 cm
y_4	$94°47'10''$	$20''$
y_5	$60°41'20''$	$20''$

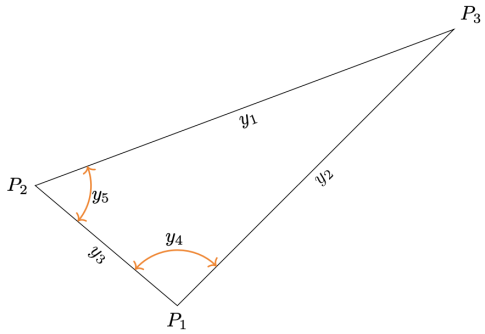


Figure 4.2: Observations of sides and angles of a triangle