Advanced Structural Geology, Fall 2022

Spherical Distributions

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Mostly from Ragan, Chapter 7

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Analyze a cluster of points on a sphere. How do you determine the mean orientation and how clustered the data are?
Mean direction is given by resultant vector

$\mathbf{R}$ of the N unit vectors. Its components are

$$R_x = \sum_{i=1}^{N} l_i, \quad R_y = \sum_{i=1}^{N} m_i, \quad R_z = \sum_{i=1}^{N} n_i, \tag{7.33}$$

where the $(l_i, m_i, n_i), i = 1, 2 \ldots, N$ are the direction cosines of the individual vectors. The *resultant length* or magnitude of this vector is

$$R = \sqrt{R_x^2 + R_y^2 + R_z^2}, \tag{7.34}$$

and its direction cosines are

$$\bar{l} = R_x/R, \quad \bar{m} = R_y/R, \quad \bar{n} = R_z/R. \tag{7.35}$$

R is also a measure of the concentration of the points about the mean. It will be nearly as large as N if the points are tightly clustered and will be smaller if they are dispersed. If data sets with different numbers of measurements are to be compared, the *mean resultant length* $\bar{R}$ is a more useful measure. This is defined as

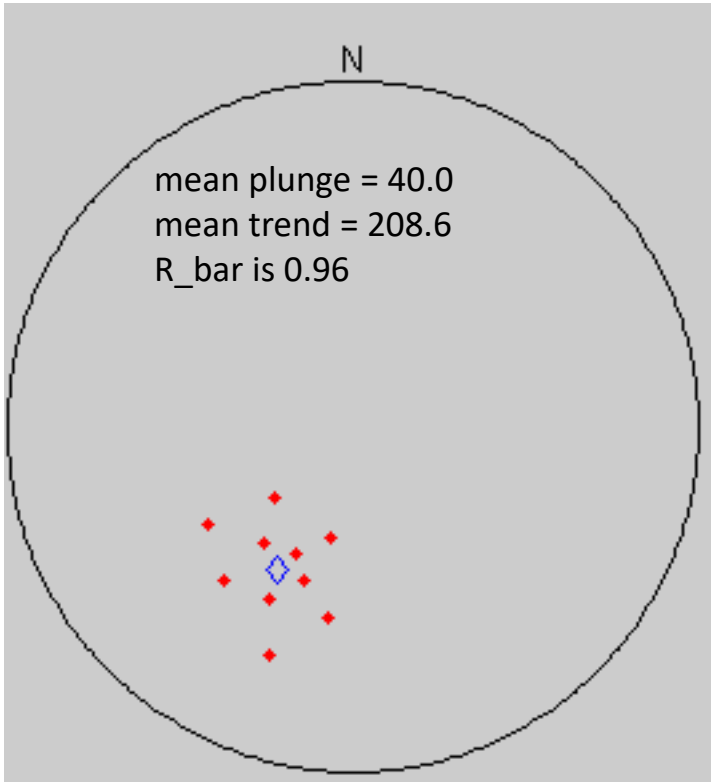
$$\bar{R} = R/N, \text{ where } 0 \leq R \leq N \text{ and } 0 \leq \bar{R} \leq 1. \tag{7.36}$$

Problem

- From 10 measured poles of bedding, determine the mean attitude (Table 7.4).

i	p	t	l_i	m_i	n_i
1	32	206	−0.76222	−0.37176	0.52992
2	30	220	−0.66341	−0.55667	0.50000
3	46	204	−0.63460	−0.28254	0.71934
4	40	198	−0.72855	−0.23672	0.64279
5	20	200	−0.88302	−0.32139	0.34202
6	32	188	−0.83979	−0.11803	0.52992
7	54	192	−0.57494	−0.12221	0.80902
8	56	228	−0.37417	−0.41556	0.82904
9	36	236	−0.45240	−0.67071	0.58779
10	44	218	−0.56685	−0.44287	0.69466
Sums			−6.38809	−3.67384	6.24920

Table 7.3: Calculation of the mean of three-dimensional vectors.

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[L, M, N] =plunge_trend_to_dir_cosines(p,t);
Rx = sum(L);
Ry = sum(M);
Rz = sum(N);

R_mag = sqrt(Rx.^2 + Ry.^2 + Rz.^2);

l_bar = Rx./R_mag; m_bar = Ry./R_mag; n_bar = Rz./R_mag;

[plunge, trend] = dir_cosines_to_plunge_trend(l_bar, m_bar, n_bar);
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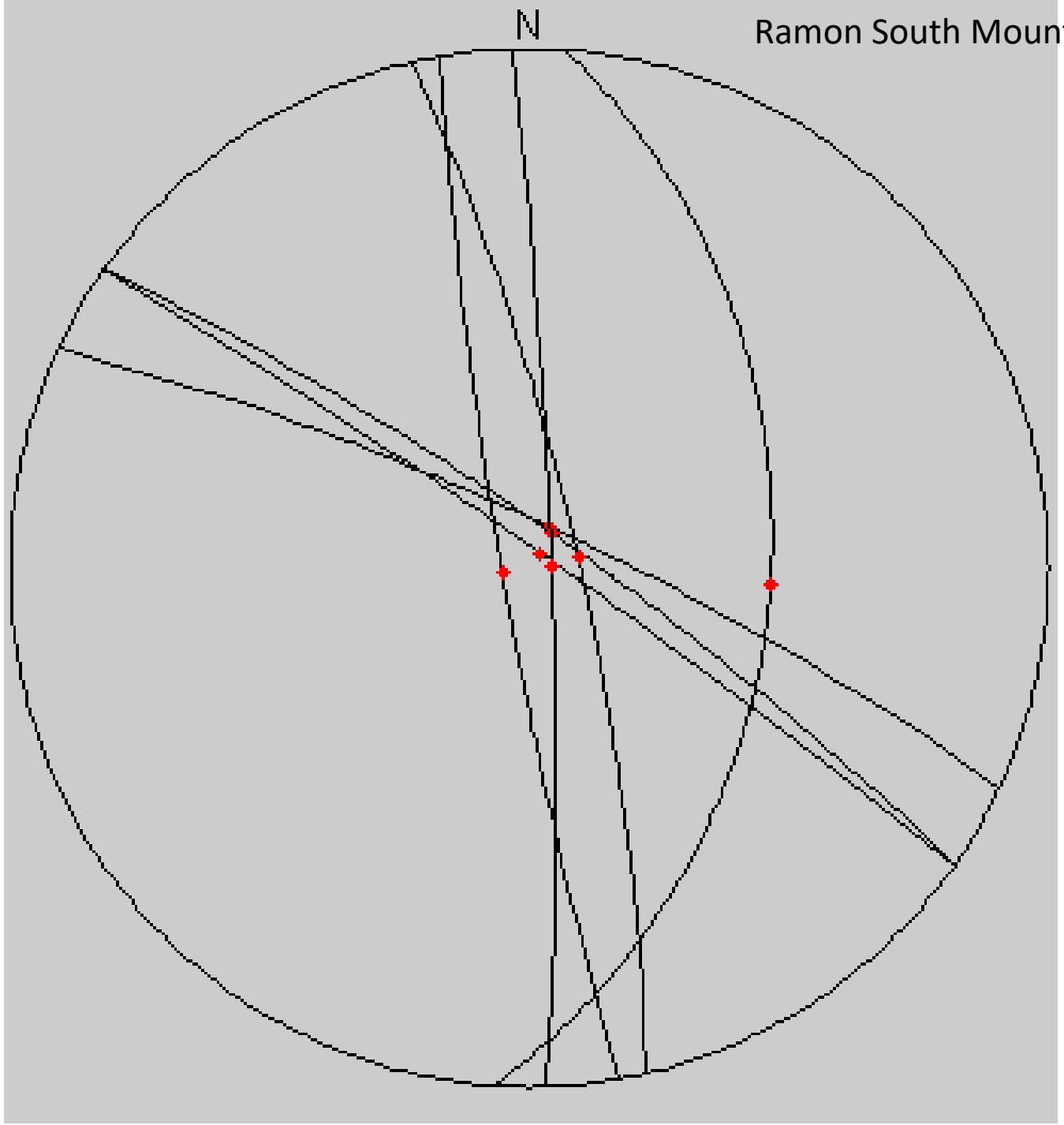

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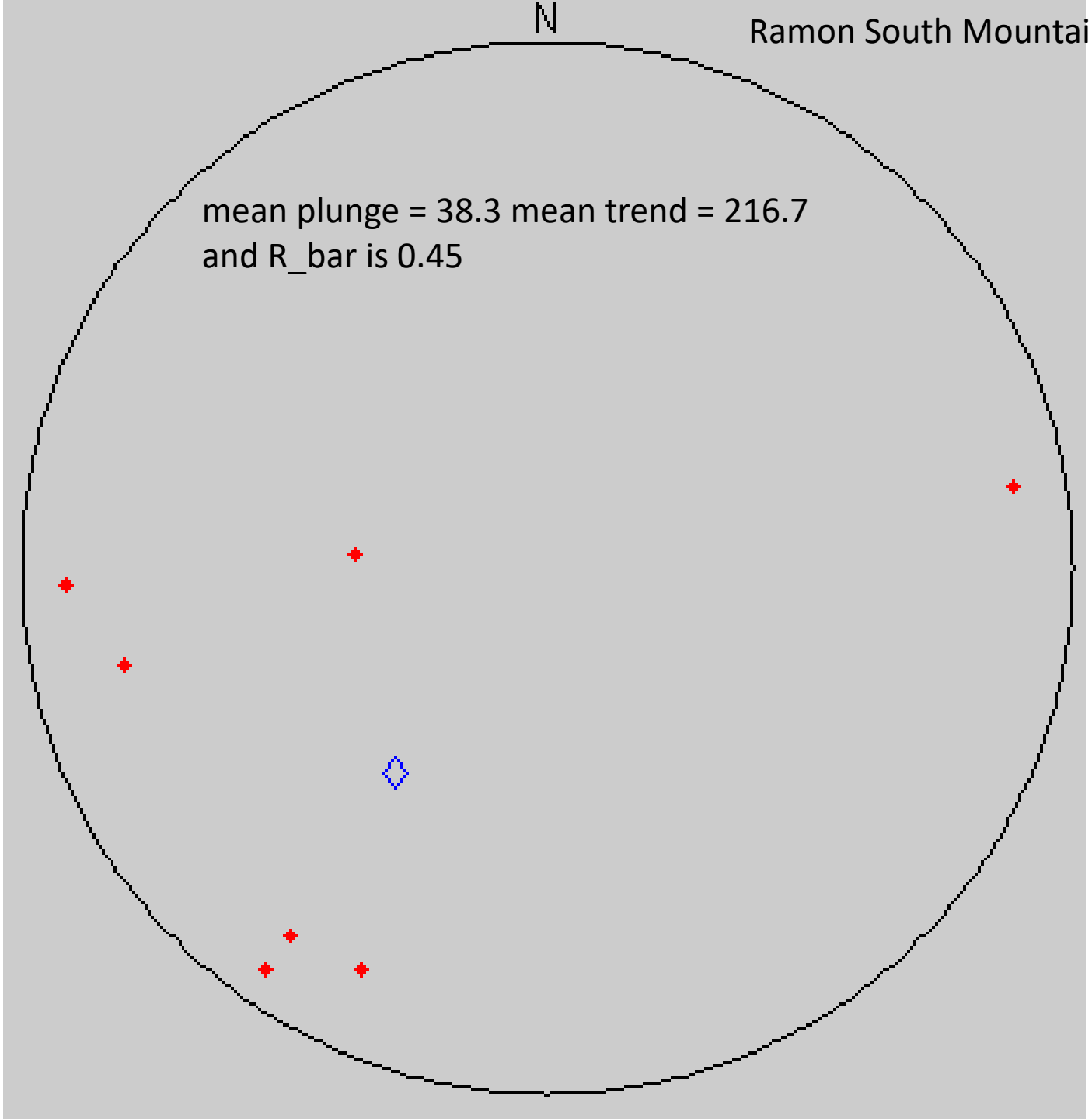

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