Adj. Geospa. Obs. Homework 5

assigned 4 Nov, 2016 Friday, due 1 week, 11 Nov.

1. Fit observed x, y, z data to a bilinear surface with model,

$$Z = a_0 + a_1 X + a_2 Y + a_3 XY$$

Use a linear version of the model to get initial approximations for the parameters a_0, a_1, a_2, a_3. σ for x, y, and z is 0.1. See attached data. Use general LS (mixed model) for the rigorous estimation. Make 2-sided global test at $\alpha = .05$

2. Fit observed X, Y, Z, x, y, z data to a 7 parameter transformation model,

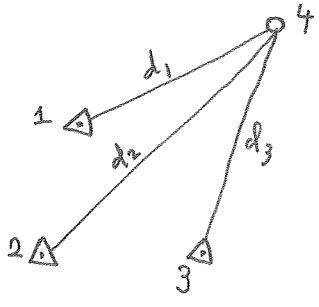
$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \lambda M \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} + \begin{bmatrix} t_x \\ t_y \\ t_z \end{bmatrix}$$

using general LS (mixed model). Use as approximations:

$\lambda = 1.0$, $\omega = 1°$, $\phi = 1°$, $\kappa = 1°$, $t_x = 0.5$, $t_y = 0.5$, $t_z = 0.0$

$\sigma = 0.07$ for all coordinates. Make 2 sided global test at $\alpha = .05$.

3. Monte Carlo experiment: For the 3 control points, and 1 "unknown" point given, compute the "perfect" distance (2D) observations. Then, for 10,000 times, (a) perturb the perfect obs. with normally distr. random numbers $\sigma = 0.2$, (b) make LS estimates of $\hat{X}_4, \hat{Y}_4$ using indirect observations, (c) save the estimates in arrays. Next plot a scatter diagram with all estimates of X_4, Y_4. Overlay on the same plot the 90% confidence ellipse, centered @ true location. How many points are inside the ellipse? for each LS estimate, "center" the 90% ellipse at the estimate $\hat{X}_4, \hat{Y}_4$ and determine & count if μ_{X_4}, μ_{Y_4} is inside that ellipse.



pnt#	x	y
1	20.0	150.0
2	10.0	110.0
3	60.0	100.0
4	100.0	170.0

problem 1.

#	x	y	z
1	2.08	2.00	6.17
2	3.00	2.18	6.37
3	3.91	2.21	6.44
4	5.05	1.84	6.75
5	1.87	2.74	6.32
6	2.88	2.88	6.53
7	3.95	3.06	6.75
8	5.01	3.06	7.09
9	1.91	3.85	6.64
10	2.87	4.07	6.90
11	4.03	3.85	7.26
12	5.00	4.21	7.46
13	2.19	4.99	7.02
14	3.18	4.94	7.23
15	4.14	5.03	7.40
16	5.03	4.93	7.85

problem 2.

#	X	Y	Z	x	y	z
1	-0.074	-0.048	-0.025	0.554	0.485	0.558
2	2.033	-0.129	-0.053	2.845	0.451	0.545
3	3.987	-0.089	0.009	4.896	0.236	0.599
4	-0.056	2.128	0.046	0.540	2.712	0.434
5	2.055	1.836	-0.015	2.781	2.577	0.432
6	4.021	1.997	0.007	4.971	2.555	0.464
7	-0.119	4.048	-0.090	0.612	4.898	0.473
8	2.044	4.063	-0.075	2.955	4.777	0.500
9	3.898	4.092	0.016	5.170	4.808	0.356
10	-0.001	0.060	1.970	0.540	0.556	2.670
11	1.936	0.057	2.022	2.622	0.378	2.832
12	3.980	0.114	1.950	4.724	0.201	2.783
13	-0.039	1.889	1.986	0.656	2.684	2.796
14	2.047	1.907	1.927	2.746	2.649	2.786
15	4.141	2.076	2.015	4.973	2.579	2.689
16	0.040	4.067	2.049	0.655	4.881	2.597
17	1.898	3.929	1.965	2.824	4.865	2.855
18	4.036	3.938	1.970	5.000	4.645	2.782