Applied Geostatistics
(응용지구통계학) (G17604)

- 2020 Final Examination -

Student ID: **Name:**

Notice

- Fill your name below:
  "I, _____, swear I solve all problems by myself in this midterm examination. I will take any disadvantages if any dishonesty such as cheating is acted on my solution."
  5 points will be deducted from your total score if you do not fill in your name above.

- Submit your solution as *.pdf or *.word file on the cyber campus.
- Please follow the format that gives a name to your report or report file:
  (Final)-(Student ID)-(Last name)-(First name)
  For example, the file name must be Final-XXXXXXX-Min-Baehyun.
- Due date: June 22, 2020, 21:30:00 PM GMT+9.
- No late submission is accepted.

Problem 1. [5 pts.]

Explain the following schemes briefly:

(1) Weak second order stationarity [2 pts.]
(2) Intrinsic hypothesis [3 pts.]

Problem 2. [10 pts.]

Draw five theoretical variogram models (i.e., nugget, linear, spherical, exponential, and Gaussian models) as a function of distance h with a range a and sill σ^2 in a graph. Compare the characteristics of the variogram models, in brief. [10 pts.]

Problem 3. [20 pts.]

In the Cartesian coordinate system, calculate semi-variogram at $(x, y) = (3, 4)$. Distance h must be calculated from the origin $(x, y) = (0, 0)$.

3-1. Isotropic model [5 pts.].

$$\gamma(h) = 3 + 4\mathrm{Exp}_{10}(h)$$

3-2. Anisotropic geometric model with a major direction N45E [5 pts.].

$$\gamma_x(h) = 3 + 4\mathrm{Exp}_{10}(h)$$

$$\gamma_y(h) = 3 + 4\mathrm{Exp}_{5}(h)$$

3-3. Anisotropic model [5 pts.].

$$\gamma_x(h) = 2 + 3\mathrm{Gauss}_{10}(h) + 4\mathrm{Sph}_{15}(h)$$

$$\gamma_y(h) = 2 + 3\mathrm{Gauss}_{5}(h) + 4\mathrm{Sph}_{10}(h)$$

3-4. Anisotropic zonal model [5 pts.].

$$\gamma_x(h) = 2 + 3\mathrm{Sph}_{10}(h) + 4\mathrm{Exp}_{15}(h)$$

$$\gamma_y(h) = 2 + 4\mathrm{Sph}_{5}(h) + 5\mathrm{Exp}_{10}(h)$$

Problem 4. [30 pts.]

Let's assume you have n sample data points.

4-1. Derive the Kriging equation and the error variance for ordinary kriging [10 pts.].

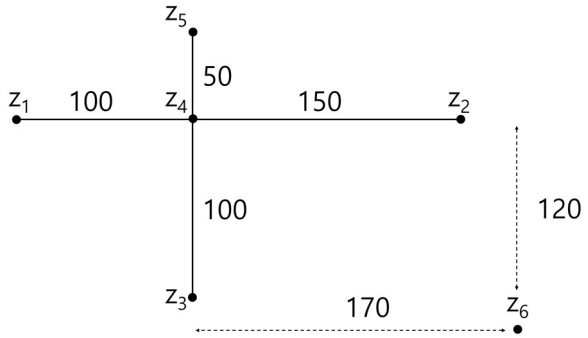
4-2. Derive the Kriging equation and the error variance for block kriging [10 pts.].

4-3. Derive the Kriging equation and the error variance for co-kriging [10 pts.].

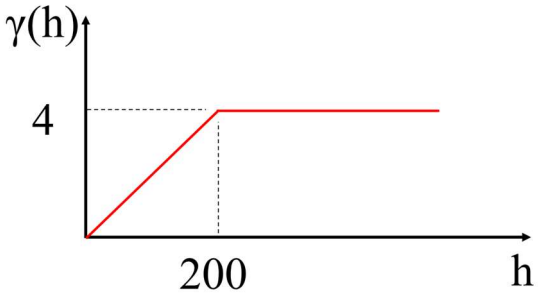
Problem 5. [15 pts.]

Estimate kriged values and its error variance values at z_4, z_5, and z_6 using ordinary kriging under the following conditions:

- Variogram model is linear with the range of 200 and sill of 4 (i.e., $\gamma(h) = 4\text{Linear}_{200}(h)$).
- Three sample values are as follows: $z_1 = 5$, $z_2=10$, and $z_3=15$.
- Round any number off to the third decimal place for your calculation.



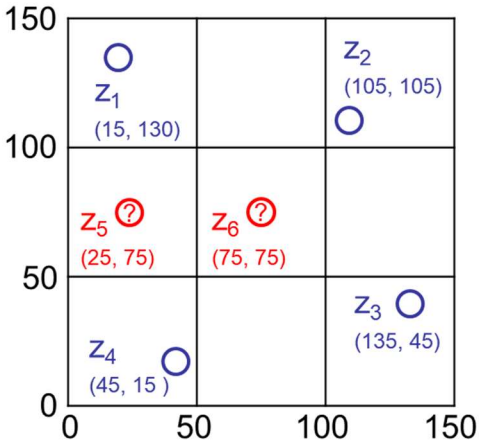
(a) Distribution of sample data z_1, z_2, and z_3



(b) Variogram model (linear)

Problem 6. [20 pts.]

X and Y are coordinates and Z is the content of gold in rock sample. That is, Z indicates gold karat. Four samples are collected from Z_1 to Z_4.



Data No.	X	Y	Z, g/ton
1	15	130	8
2	105	105	9
3	135	45	12
4	45	15	10
5	25	75	?
6	75	75	?

6-1. Estimate gold karat at the gridblock including Z_5 using block kriging with four quasi-point measurements.

6-2. Estimate gold karat at the gridblock including Z_6 using block kriging with four quasi-point measurements.

---------- This is the End of the Final Examination ----------