Spatial Information Modeling for Climate and Energy Systems
(기후에너지 공간정보모델링) (38541)

- 2021 Midterm Examination -

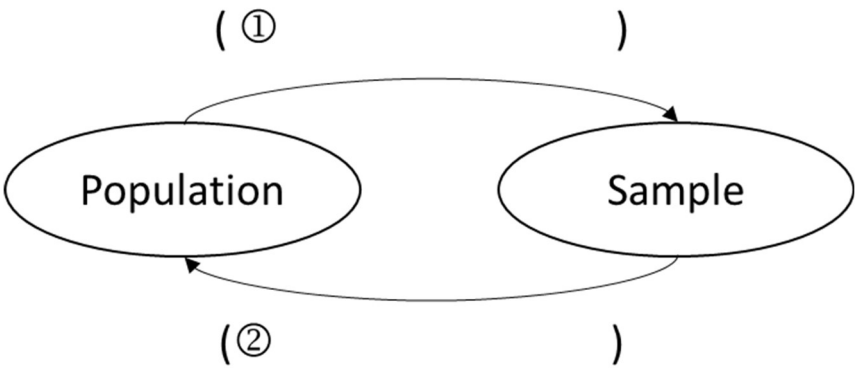
Student ID: **Student Name:**

Notice

- Fill your name below and write the whole sentence in your answer sheet:
  "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.
- **You MUST solve each problem by hand.**
- Submission Deadline: 20:30~20:45 PM, April 29, 2021.
- No late submission is accepted.
- Submit your solution as *.pdf or *.word file on the cyber campus.
- Please follow the format that gives a name to your solution file:
  (Mid)-(Student ID)-(Last name)-(First name)
  For example, the file name must be Mid-XXXXXXX-Min-Baehyun.

Problem 1. [4 pts.]

Fill in the two blanks.



Problem 2. [4 pts.]

Provide the full name of each acronym:

2-1. BLUE

2-2. MVUE

Problem 3. [5 pts.]

List six steps to apply geostatistics in order.

Problem 4. [7 pts.]

For the transmissivity data acquired from *n* locations, the mean square error for the estimate $\widehat{T_0}$ can be quantified as σ_0^2 as follows:

$$\sigma_0^2 = \frac{1}{n}\left(\widehat{T_0} - T_1\right)^2 + \frac{1}{n}\left(\widehat{T_0} - T_2\right)^2 + \cdots + \frac{1}{n}\left(\widehat{T_0} - T_n\right)^2$$

Show your work to have a best estimator (i.e., minimum-variance estimator).

Problem 5. [10 pts.]

Prove that the correlation coefficient ρ is in the range between -1 and 1 using the formula below.

$$\mathrm{Var}\left(\frac{\sigma_v}{\sigma_u}u \pm v\right) \geq 0$$

Problem 6. [10 pts.]

Statistically, Baehyun solves 90% of questions correctly. When Baehyun solves a multiple-choice question with five possible answers correctly, calculate the probability of each case:

6-1. Baehyun solves the question correctly because he knows the correct answer.

6-2. Baehyun solves the question correctly although he does not know the correct answer.

Problem 7. [10 pts.]

Draw a boxplot for a sample = {5, 13, 3, 6, 45, -12, 36, 6, 9, 12, 6}. On the boxplot, include the minimum, 1st quartile, 2nd quartile, 3rd quartile, maximum, and IQR.

Problem 8. [10 pts.]

Calculate the mean and standard deviation of the exponential pdf (i.e., probability density function) where $f(x; k) = k \cdot \exp(-kx)$.

Problem 9. [10 pts.]

There is an infinite population composed of nonnegative values of which the mean and variance are μ and σ^2, respectively. Explain why z^* tends to follow a log-normal distribution when z^* is the product of n data points sampled from the population.

Problem 10. [5 pts.]

Explain the following schemes, in brief:

10-1. Weak second order stationarity [2 pts.]

10-2. Intrinsic hypothesis [3 pts.]

Problem 11. [20 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 single graph. Compare characteristics of these variogram models, in detail.

Problem 12. [5 pts.]

In the Cartesian coordinate system, calculate the semi-variogram at $(x, y) = (3, 4)$ when the isotropic semi-variogram model is given as $\gamma(h) = 3 + 4\mathrm{Exp}_{10}(h)$. Distance h must be calculated from the origin $(x, y) = (0, 0)$.

---------- This is the End of the Midterm Examination ----------