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

- 2022 Midterm Examination -

Student ID: **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: 09:30~10:45 PM, April 25, 2022.
- Submission Deadline: 10:45~11:00 AM, April 25, 2022.
- No late submission is accepted.
- Round off all your answer to the nearest hundredth (당신의 모든 답을 소수점 둘째자리에서 반올림하시오).
- 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. [15 pts.]

Suppose that there is an oil reservoir of which the size is 10 km x 10 km x 20 m (height) in the *x*-, *y*-, and *z*-directions, respectively. A field operator collects a rock core sample whose diameter is 5 cm and length is 20 cm.

1-1. How many core samples are required to do sampling of 0.001% of the total reservoir volume?

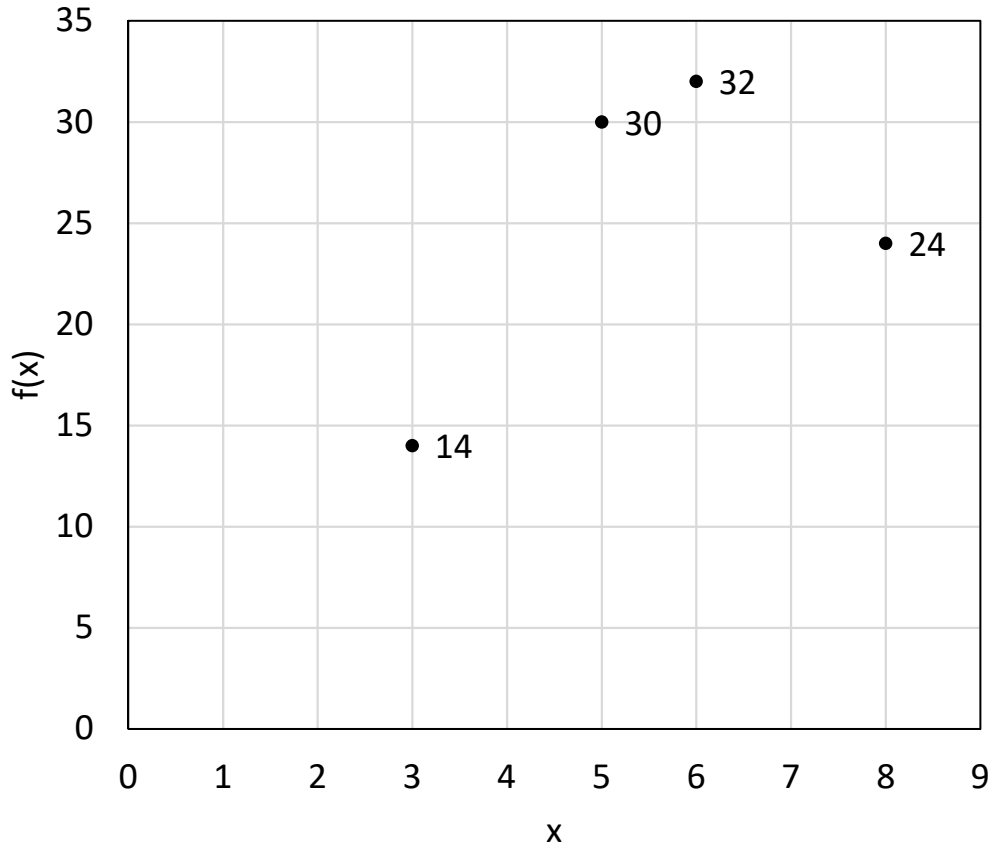
1-2. For problem 1-1, how much is the expected total cost where the unit sampling cost per core is $50.0?

1-3. Suppose that four vertical wells were drilled and 20 m long core samples were collected from each well. Calculate the percentage of the total volume of the four core samples to the total reservoir volume.

Problem 2. [15 pts.]

The figure below shows four data points (x, f(x)): (3, 14), (5, 30), (6, 32), and (8, 24).

Estimate f(x=7) using three different methods based on your statistical skills. Note that your estimates must be rational from the point of view of statistics.



Problem 3. [10 pts.]

Calculate covariance and correlation coefficients of z and u.

Sample data z	5	27	3	6	38	-2	5
Sample data u	0	12	2	3	25	0	5

Problem 4. [5 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 5. [15 pts.]

Given that a triangular distribution f(z; lower limit, upper limit, mode) = f(z; 10, 35, 25),

5-1. Draw both pdf and cdf of f(z) together in a plot.

5-2. Calculate p($15 \leq z \leq 20$), p($20 \leq z \leq 30$), p($z \geq 32$).

5-3. Calculate the three quartiles: Q1, Q2, and Q3.

Problem 6. [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 7. [10 pts.]

Prove the sample variance $s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(z_i - \bar{z})^2$ is the unbiased estimator for the population variance σ^2.

Problem 8. [10 pts.]

Explain the following schemes, in brief:

8-1. Weak second order stationarity

8-2. Intrinsic hypothesis

Problem 9. [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.

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