Course Outline

- Course Title: Statistical Hydrology
- Instructor: Dr. Kim, Young-Oh (tel: 880-8916, email: yokim05@snu.ac.kr)
- Teaching Assistant: Kim, Gi Joo (tel: 880-8354, email: gjk_0494@snu.ac.kr)
- Lecture Hours & Location: Monday 13:15 ~ 16:00, Room 35-315
- Course Grades: Test(20%) + Quiz(20%) + In-class Performance(30%) + Term Project(30%)
- Remarks

  Test (20pt) - Open book, 3 hours, 5~6 problems, 1 time.

  Quizzes (20pt) - Closed book, 2~3 out of the designated problems in advance, several times.

  In-class Performance (30pt)

  - The weekly lecture topic is shown in the course schedule and students should read the corresponding part of text in advance.
  - A list of key questions is given a week before every lecture. and the 'In-class Performance' is mainly evaluated with quantitative and qualitative aspects of the students' answers during the class. *(25pt)*
  - Each student should make at least one presentation in class, which is also included in the 'In-class Performance'. *(5pt)*
  - In conclusion, interactive questions & discussions are very important in 'In-class Performance' evaluation. So, be active for the interactive class participation!

  Term Projects (30pt)

  - Students are group into 2~3 groups to carry out each of two 'Term Projects'.
  - Each team should submit a maximum 3-page (without tables or figures) extended abstract (in Korean) and a presentation file for each project by the due date. You may follow any good format available from an international conference for the extended abstract.
  - The question of the first 'Term Project' is 1) what is the best parameter estimation scheme' of GEV and GLO, and 2) what are the key differences between GEV and GLO? The first question should be answered on the basis of broad review of the recent articles while the second question should be answered by comparing the distribution shapes of GEV and GLO for various values of their parameters.
  - The second 'Term Project' should generate a 500-year time series of inflows for the Boryeong dam that reproduces the multi-year drought. Each team should choose a most appropriate time series model from the recent articles and verify that the model your team choose performs better than the conventional ARMA model for the objective of the second project.

- Primary Texts

((P1)) Hann, C. T. (2002). *Statistical Methods in Hydrology*, 2nd Edition, The Iowa State University Press.

((P2)) Hirsch, R. M., Helsel, D. R., Cohn, T. A., and Gilroy, E. J. (1992). "Chapter 17. Statistical Treatment of Hydrologic Data", *Handbook of Hydrology*, edited by D. R. Maidment, McGraw-Hill.

((P3)) Stedinger, J. R., Vogel, R. M., and Foufoula-Georgiou, E. (1992). "Chapter 18. Frequency Analysis of Extreme Events", *Handbook of Hydrology*, edited by D. R. Maidment, McGraw-Hill.

((P4)) Hosking, J. R. M. and Wallis, J. R. (1997). *Regional Frequency Analysis: An Approach Based on L-Moments,* Cambridge University Press.

((P5)) Salas, J. D. (1993). "Chapter 19. Analysis and Modeling of Hydrologic Time Series", *Handbook of Hydrology*, edited by D. R. Maidment, McGraw-Hill.

((P6)) Salas, J. D., Delleur, J. W., Yevjevich, V., and Lane, W. L. (1980). *Applied Modeling of Hydrologic Time Series*, Water Resources Publications.

((P7)) Box, G. E. P., Jenkins, G. M. and Reinsel, G. C. (2016). *Time Series Analysis: Forecasting and Control*, 5th Edition, Wiley.

- Supplemental Texts and Articles

((S1)) Vogel, R. M., Wilson, I., and Daly, C. (1999). “Regional Regression Models of Annual Streamflow for the United States”, *Journal of Irrigation and Drainage Engineering*, 125(3), pp.148-157.

((S2)) Young, A. R. (2006). “Stream flow Simulation within UK Ungauged Catchments using a Daily Rainfall-runoff Model”, *Journal of Hydrology*, 320(1), pp.155-172.

((S3)) Griffis, V. W. and Stedinger, J. R. (2007). "Evolution of Flood Frequency Analysis with Bulletin 17", *Journal of Hydrologic Engineering*, 12(3), pp.283-297.

((S4)) Dawdy, D. R., Griffis, V. W., and Gupta, V. K. (2012). “Regional Flood-Frequency Analysis: How We Got Here and Where We Are Going”, *Journal of Hydrologic Engineering*, 17, pp.953-959.

((S5)) Salas, J. D. and Smith, R. A. (1981). "Physical Basis of Stochastic Models of Annual Flows", *Water Resources Research* 17(2), pp.428-430.

((S6)) Hipel, K. W., McLeod, A. I., and Lennox, W. C. (1977). "Advances in Box-Jenkins Modeling", *Water Resources Research* 13(3), pp.567-586.

((S7)) Bergman, M. J. and Delleur, J. W. (1985). "Kalman Filter Estimation and Prediction of Daily Streamflow", *Water Resources Bulletin* 21(5), pp.815-832.

((S8)) Grygier, J. C., Stedinger, J. R., and Yin, H.-B. (1989). "A Generalized Maintenance of Variance Extension Procedure for Extending Correlated Series", *Water Resources Research* 25(3), pp.345-349.

((S9)) Harrigan, S., Prudhomme, C., Simon P., Smith, K., and Tanguy, M. (2017). "Benchmarking Ensemble Streamflow Prediction Skill in the UK", *Hydrology and Earth Science System Sciences*, hess 2017-449 (in review).

- Other References

Helsel, D. R. and Hirsch, R. M. (1992). *Statistical Methods in Water Resources*, Elsevier.

Kottegoda, N. T. and Rosso, R. (1997). *Statistics, Probability, and Reliability for Civil and Environmental Engineers*, McGraw-Hill.

McCuen, R. H. (1993). *Statistical Hydrology*, Prentice Hall.

Wilks, D. S. (1995). *Statistical Methods in the Atmospheric Sciences*, Academic Press.

Bras, R. L. and Iturbe, I. R. (1985). *Random Functions and Hydrology*, Dover.

- Course Schedule

Week	Date	Topic	Assignment
1	9/3	Course Introduction ((P1)) Chap 2 Probability ((P1)) Chap 3 Properties of Random Variables	
2	9/10	((P1)) Chap 3 Parameter Est., Chebyshev Ineq. ((P1)) Chap 4 Discrete Probability Distributions ((P1)) Chap 5 Normal Distribution Family	
3	9/17	((P1/P3)) Chap 6 GEV & Pearson Distribution Families ((P1/P3)) Chap 7 Flood Frequency Analysis	
4	9/24	*Chuseok*	
5	10/1	((P4)) L-Moments ((P4)) Regional FFA: Index Flood Method	Presentation Presentation
6	10/8	((P4)) Regional FFA: Index Flood Method ((S1/S2)) Regional Regression	Presentation Presentation
7	10/15	((S3)) US Bulletin 17B	Presentation
8	10/22	((S4)) Regional FFA: State-of-the-Art *Term Project I*	Presentation *Presentation*
9	10/29	((P5/P6)) Statistical Properties of Hydrologic Time Series ((P5/P6)) Testing and Removing Nonstationarities	
10	11/5	((P5/P6/S5)) Introduction to Time Series Modeling ((P5/P6/S6)) AR Modeling: Identification	
11	11/12	((P5/P6/S6)) AR: Parameter Est & Diagnostic Check ((P5/P6/S6)) Univariate ARMA	
12	11/19	*Test*	
13	11/26	((P5/P6)) Periodic ARMA ((P7/S6)) Seasonal ARIMA	
14	12/3	((P5/P6)) Multivariate Time Series Modeling ((S7)) Kalman Filter	 Presentation
15	12/10	((P5/S8)) Record Augmentation and Extension ((S9)) Ensemble Streamflow Prediction	Presentation Presentation
16	12/17	*Term Project II*	*Presentation*

- Questions and Thought

- Why is uncertainty important in hydrology
- What are main sources of uncertainty in hydrology?
- How can you define 'Statistics'?
- Is 'Probability' different from 'Likelihood'?
- Why should the conditional probability P(A|B) be calculated from the another conditional probability P(B|A) in the Bayes Theorem equation?
- Does a pdf exceed 1?
- What would you do first when you have data?
- What kinds of statistical characteristics are important in hydrology?
- Does the perfect relationship always guarantee correlation coefficient = 1 between two random variable? Why or why not?
- Can you explain definition of the marginal distribution by a very easy graphical way?
- Solve the Haan Problem 2.15.

- Assignment 1 (Due Sep. 10)

  Solve the Haan Problems 2.4, 2.6, 2.8, 2.12, 2.14, 2.16, 3.2, 3.3, 3.4, 3.16 as well as all the Examples of the Haan Chapter 2.