I. **Pre-class material** Either read the indicated textbook sections OR watch the indicated video.

(a) **Sections to Read** (All content from Blitzstein and Hwang's *Introduction to Probability* unless otherwise noted). A digital copy of the textbook is available for free via the authors' website.

- 7.2 and 7.3

(b) **Videos to Watch** (All videos from Blitzstein's Math 110 YouTube channel, unless otherwise noted)

- Lecture 20: Multinomial and Cauchy (from beginning to 8:00)
- Lecture 21: Covariance and Correlation (from beginning to 33:00)

II. **Objectives** (By the end of the day's class, students should be able to do the following:)

- State and apply 2D (and higher dimensional) versions of LOTUS
- Compute the covariance of a pair of random variables, and prove properties of covariance.
- Calculate the correlation of a pair of random variables and interpret its value as the strength of a linear relationship.
- Determine the variance of certain random variables by computing appropriate covariances.

III. **Reflection Questions** (Submit answers on Gradescope `https://www.gradescope.com/courses/425901`)

1) Suppose X and Y are (not necessarily independent) Bernoulli-$(1/2)$ variables, and let $p = P(X = 1, Y = 1)$. Use 2D LOTUS to express $E[XY]$ in terms of p.
2) Determine whether each of the following statements are true or false. Briefly justify your answer by citing the relevant property of Variance or Covariance from section 7.3.
   i. $\text{Var}(X + X) = \text{Var}(X) + \text{Var}(X)$.
   ii. $\text{Cov}(X, X + 5) = \text{Var}(X)$.
   iii. If X and Y have $\text{Cov}(X, Y) = 0$, then X and Y are independent.
   iv. If X and Y are independent and both have variance 1, then $\text{Var}(X - Y) = \text{Var}(X) - \text{Var}(Y) = 0$.

IV. **Additional Feedback** Are there any topics you would like further clarification about? Do you have any additional questions based on the readings / videos? *If not, you may leave this section blank.*