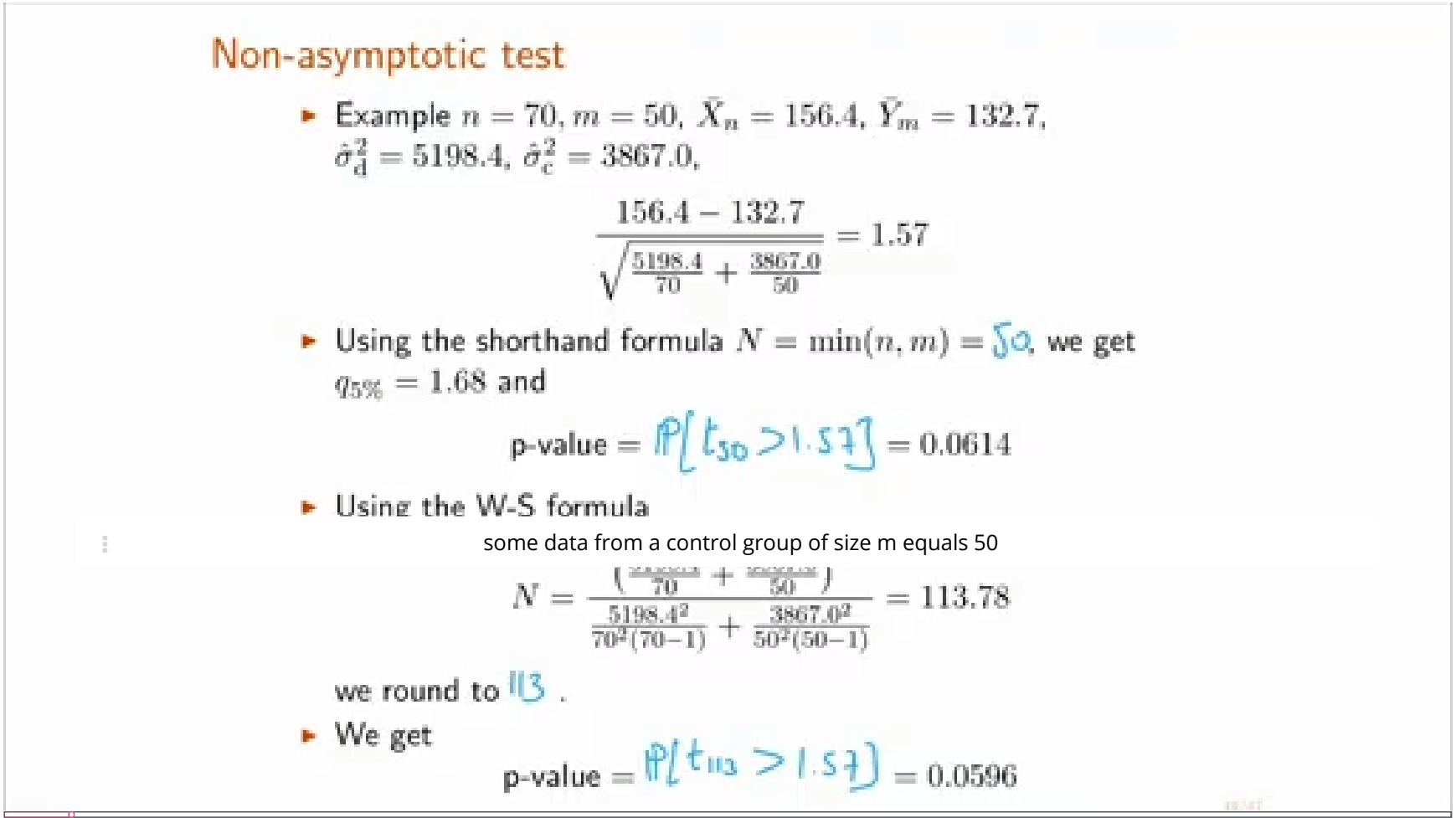
2. Worked Example: Two-Sample T-test with Small Sample Sizes

Note: At around 5:15 mark in the following video, Prof. Rigollet says "So clearly, you reject (the null hypothesis)" while the correct assertion should have been "So clearly, you fail to reject (the null hypothesis)".

Worked Example: Two-Sample T-test with Small Sample Sizes



0:26 / 9:21 1.50x

Video

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Non-asymptotic Two-Sample Test using t-statistic

Assume

- $X_1, \ldots, X_n \overset{iid}{\sim} \mathcal{N}(\mu_X, \sigma_X^2)$,
- $Y_1, \ldots, Y_m \overset{iid}{\sim} \mathcal{N}(\mu_Y, \sigma_Y^2)$,
- $X_1, \ldots, X_n, Y_1, \ldots, Y_m$ are independent.

Then, for any n and m, the distribution of the test statistic below is approximated by a t-distribution:

$$\frac{\overline{X}_n - \overline{Y}_m - (\mu_X - \mu_Y)}{\sqrt{\hat{\sigma}_X^2/n + \hat{\sigma}_Y^2/m}} \overset{\text{approx.}}{\sim} t_N$$

where the degrees of freedom N is given by the **Welch-Satterthwaite formula** :

$$\min(n, m) \leq N = \frac{\left(\hat{\sigma}_X^2/n + \hat{\sigma}_Y^2/m\right)^2}{\frac{\hat{\sigma}_X^4}{n^2(n-1)} + \frac{\hat{\sigma}_Y^4}{m^2(m-1)}} \leq n + m$$

Discussion

Topic: Unit 4 Hypothesis testing:Lecture 14: Wald's Test, Likelihood Ratio Test, and Implicit Hypothesis Test / 2. Worked Example: Two-Sample T-test with Small Sample Sizes

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