5th April '2024

Chapter 3 :→ 2-parameter Methods

- Same thing as ch-2, except now with partial derivatives

  MLE's ⟶ joint MLE's

  * Do not need to do 2nd derivative test.
  * Do not need to compute interval estimate.

- Introduced the chi-square distribution.
  - ↳ 3 properties
  - ↳ Discussed degrees of freedom.

Chapter 4 : Significance testing

- Likelihood Ratio test (statistic)

  ★★ know how to perform LRT.
  - ↳ Sampling distribution and test statistics.

- Do LRT with data or with summarized data.

  Chi-Square tests :

  1. Goodness of fit (1-sample, 1-variable)
  2. Test of homogeneity (2+ samples, 1-variable)
  3. Test of independence (1-sample, 2-variables)
     - ↳ Cause and effects.

★★★ Writing Conclusions to hypothesis tests.

- Recognizing and defining Simple vs. Composite Hypothesis.

Chapter 5: Confidence Intervals

- CI's are found through three methods:
  1) Inverting a hypothesis test
  2) L.I's $\iff$ C.I's (only convenient, if you have R)
  3) Using the asymptotic Normal Distribution of MLE.

Chapter 6: Normal Theory.

- State properties of Normal and χ^2 Distribution.
- Basic assumptions of our Normal Data

$$Y_i = \mu_i + \varepsilon_i \quad ; \quad \varepsilon_i \overset{iid}{\sim} \mathcal{N}(0, \sigma^2)$$

- Three different types of Models.
  1) 1-sample Model:

$H_0: \mu = \mu_0$ with σ^2-known $D = g(Z^2)$ (vs) σ^2-unknown $D = h(T^2)$

$H_0: \sigma^2 = \sigma_0^2$

C.I's for all three tests (pivotal quantity defns!)

↳ how do the assumptions change?

  2) 2-sample Model:

$H_0: \mu_1 = \mu_2$ with $\sigma_1^2 = \sigma_2^2$ known
$\sigma_1^2 = \sigma_2^2$ unknown
$\sigma_1^2 \neq \sigma_2^2$ (unknown)
} How to estimate σ^2.

t.test( ) in R ← how to read output and write conclusions.

C.I formulas for all three hypotheses.

Using tables to get critical values.

★ Box blots and their anatomy / interpretation.

★ Histograms.

★ How to [redacted] comment on a graph

3) Straight-line Model :

◎ $Y_i = \alpha + \beta x_i + \varepsilon_i$

◎ Defined residuals, $\hat{\varepsilon}_i$

◎ Plotting data and assessing linear model.

◎ Fit the model in R, using lm( ).

↳ read the output and state the fitted model.
evaluate R^2, get the estimated variance.
test hypotheses on α and β, and predict
y at certain values of x. Interpreting α and β.

◎ Residual Analysis.

↳ res vs fitted : Constant variance, linearity assumptions, outliers / leverage points.

★ [redacted] Q-Q plots of residuals : Normality Assumption.

◎ Paired Measurements :

↳ A way to reduce a 2-sample test to a 1-sample test.

$H_0: \mu_d = 0$; $H_a: \mu_d \neq 0$
$H_a: \mu_d > 0$
$H_a: \mu_d < 0$

(Before > After)
(Before < After)

↳ Based on Example