SI424: Statistical Inference
Project Report

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Project Title:

Data set used:

Associated GitHub Repository:

The GitHub repository can accessed at:

ABSTRACT:

COMMON NOTATIONS:

$\mathcal{N}(\mu, \sigma^2)$ denotes the Normal distribution with mean μ and variance σ^2.

Parameter estimation Problem 1:
We have two countries - Italy and Australia.
The population growth rate of Italy follows $\mathcal{N}(\mu_1, \sigma_1^2)$, while that of Australia follows $\mathcal{N}(\mu_2, \sigma_2^2)$.
Given samples of population growth rate for both countries, determine the parameters $\mu_1, \sigma_1^2, \mu_2, \sigma_2^2$.

Parameter estimation Problem 2:
The graph of USA population vs age, looks like the Half Normal distribution, with pdf:

$$Y \sim \mathcal{N}(0, \sigma^2)$$
$$X = |Y|$$
$$p_X(x) = \frac{\sqrt{2}}{\sqrt{\pi\sigma^2}} \exp\left(\frac{-x^2}{2\sigma^2}\right), \quad \forall x \geq 0$$

Given a sample of age of people, determine the parameter σ for this distribution.

Hypothesis Testing Problem 1:
We have two countries - Italy and Australia.
We have gender ratios $r = (r_1, ..., r_n)$ of different years given to us for a specific country.
We observe that $r_i \sim \text{Uniform}[\theta - \beta, \theta + \beta]$.
H0: Country is Italy
H1: Country is Australia
Test1: We reject H0 if $\text{mean}(r) < 1.0$
Test2: We reject H0 if $\theta_{MLE} = \frac{max(r) + min(r)}{2} < 1.0$

Hypothesis Testing Problem 2:
We have two countries - Italy and Australia.
We have population growth rate $g = (g_1, ..., g_n)$ of different years given to us for a specific country.
We observe that $g_i \sim \mathcal{N}(\mu, \sigma^2)$
H0: Country is Italy
H1: Country is Australia
Test: We reject H0 if $\mu_{MLE} = \text{mean}(g) < 1.2$