7. SAMPLING DISTRIBUTIONS [IT2110]

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Simple Random Sampling (SRS)

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*Each unit in the population (N) has **same chance** of being selected to the sample (n).*

"A SRS is a set of **independent and identically distributed (iid)** observable r.v.s.

Statistic

2

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- A function of observable r.v.s that does not depend on any unknown
- parameters is called a statistic.

Eg: Sample Mean

Sampling Distributions

3

"The probability distribution of a statistic is known as a ***sampling distribution***.

Sampling Distribution of the Mean

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Sampling Distribution of the Mean

- Let X_1, X_2,…, X_n be a random sample of size n from a population with mean μ and variance σ^2. Then,

$$E(\bar{X}) = \mu$$
$$V(\bar{X}) = \sigma^2/n$$

- The standard deviation of a sampling distribution of a statistic is called the **Standard Error** (SE).
- Although the r.v.s were identically distributed, a specific distribution type was not needed.

Sampling Distribution of the Mean

- Let X_1, X_2,…, X_n be a random sample of size n from a ***Normal*** population with mean μ and variance σ^2. Then,

$$\boldsymbol{\bar{X} \sim N(\mu, \sigma^2/n)}$$

Examples

1) A particular brand of drink has an average of 12 ounces per can. As a result of randomness, there will be small variations in how much liquid each bottle really contains. It has been observed that the amount of liquid in these bottles is normally distributed with $\sigma = 0.8$ ounce. A sample of 10 bottles of this brand of soda is randomly selected from a large lot of bottles, and the amount of liquid, in ounces, is measured in each. Find the probability that the sample mean will be within 0.5 ounce of 12 ounces.

Examples

2) A company that manufactures cars claims that the gas mileage for its new line of hybrid cars, on the average, is 60 miles per gallon (mpg) with a standard deviation of 4 mpg. A random sample of 16 cars yielded a mean of 57 miles per gallon. If the company's claim is correct, what is the probability that the sample mean is less than or equal to 57 mpg? What assumptions did you make?

Central Limit Theorem (CLT)

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Central Limit Theorem

- Let X_1, X_2,…, X_n be a large random sample of size n from a population with mean μ and variance σ^2. Then,

$$\boldsymbol{\bar{X} \sim N(\mu, \sigma^2/n)}$$

- A rule of thumb is that the sample size n must be at least **30**.
- Central Limit Theorem can be applied regardless of the distribution of the population.

Thanks!

Any questions?