USAID OD AMERIČKOG NARODA | Asistencija regulativi i reformi energetskog sektora

Sample design and selection - recommendations -

Tatjana Konjić

Mostar, 22.03.2012.

This presentation is made possible by support from the American People sponsored by the United States Agency for International Development (USAID). The contents are the sole responsibility of the author/s and do not necessarily reflect the views of USAID or the United States Government.

Bosnia and Herzegovina (BiH) Regulatory and Energy Assistance Project (REAP)
USAID Contract No. EPP-I-00-03-00004-00, Task Order 5
Implemented by Advanced Engineering Associates International, Inc. as USAID Contractor

I. DEFINING OBJECTIVES

- **The main objective of the load research analysis:**
  - **Characterization of customers and**
  - **Load profiling**

2. DEFINING POPULATION

- **Targeted population: customers connected to 0,4 kV network:**
- **Basic groups:**
  - **Households**
  - **Commercial consumption on low voltage with no capacity metering**
  - **Public lighting**

3. DEFINING SUBGROUPS

- **Households:**
  - **Urban area with central heating**
  - **Urban area without central heating**
  - **Suburb**
  - **Rural areas**
- **Public lighting – no subgroups**

3. DEFINING SUBGROUPS

- **Commercial consumption on low voltage with no capacity metering:**
  - **Workshops**
  - **Shops and handcrafts**
  - **Service providers (restaurants, small hotels, bars)**
  - **Crafts**
  - **Administration buildings**
  - **Banks**
  - **Health institutions**
  - **Schools, religious facilities, sports halls**
  - **Water-supply pump stations**
  - **Central heating pump stations**
  - **Other customers**

3. DEFINING SUBGROUPS

- If the distribution company is organized into several subsidiaries according to geographical location, we need to think through whether this division needs to be applied for each subsidiary.
- If the geographical features are similar or if geographic feature do not affect the subgroup, the customers from all subsidiaries within one subgroup should be addressed collectively.

4. DEFINING STATISTICAL FEATURES OF EACH SUBGROUP BASED ON CALCULATION DATA

- Number of customers in one group
- Average annual consumption
- Variance/Standard deviation
- Maximum consumption
- Minimum consumption

5. SAMPLING TECHNIQUE

- **Stratification**
- **Stratification variable ⇒ electrcity consumption**
- **Auxilliary stratification variable ⇒ employed capacity**

6. DEFINING NUMBER OF STRATA

- **Recommended number of strata is 4 in each subgroup**

7. DEFINING STRATA BOUNDARIES

- **Dalenius – Hodges method or cummulative $\sqrt{f\,u}$ method**
- **The population is divided into short intervals based on stratification variable.**
- **Each interval has frequency *f* and interval length *u***

8. DEFINING THE MAXIMUM ALLOWED ERROR

- Maximum error of 10% or less if the subgroup has significant impact on the consumption of the whole group.
- Maximum error of 15% or less, if the customer subgroup has somewhat siginificant impact on the consumption of the whole group.
- Maximum error of 20% or less, if the subgroup has insignificant impact on the consumption of the whole group.

9. DEFINING CONFIDENCE INTERVAL

- **Apply confidence interval of 90% or higher**

10. CALCULATING NUMBER OF SAMPLES

$$n = \left(\frac{\sigma}{\mu}\right)^2 \cdot \frac{z^2}{r^2}$$

n – sample size,
r – max allowed error,
σ - standard deviation for total consumption (kWh),
μ - medium value for total consumption (kWh),
z – standard normal variable (z is 1.645 for confidence interval of 90%).

11. ALLOCATING SAMPLES BY STRATA

$$n_h = n * (N_h * S_h) / [\Sigma (N_i * S_i)]$$

n_h – sample size for stratum *h*,

n – total sample size,

N_h – population sample for stratum *h*,

S_h – standard deviation for stratum *h*,

N_i – total population stratum *i*

S_i – standard deviation stratum *i*.

12. CUSTOMER IDENTIFICATION

- Identify customers where the meters will be installed according to number of samples in each stratum.
- Statistical features of identified customers in a stratum should be similar to the statistical features of all customers in the stratum.