

An advertising firm, interested in determining how much to emphasize television advertising in a certain county, decides to conduct a stratified random sample survey to estimate the average number of hours each week that households within the county watch television. The county contains two towns, A and B, and a rural area. Town A is built around a factory, and most households contain factory workers with school-aged children. Town B is an exclusive suburb of a city in a neighbouring county and contains older residents with few children at home. There are 155 households in town A, 62 in town B, and 93 in the rural area.

(f) A prior survey suggests that the stratum variances are approximately $S_1^2 = 25$, $S_2^2 = 225$, $S_3^2 = 100$. We will use \bar{y}_{ST} to estimate the population mean. Choose the sample size to obtain a bound on the variance equal to 1 hour if the allocation fractions are $n_1/n = 1/3$, $n_2/n = 1/3$, $n_3/n = 1/3$.

(g) It has been found that obtaining an observation from a rural household costs more than a response in town A or B. The increase is due to the costs of driving from one rural household to another. The cost per observation in each town is estimated to be \$9, and the costs per observation in the rural area to be \$16. There is no fixed overhead cost. Find the overall sample size n and the stratum sample sizes n_1 , n_2 , n_3 that allow the advertising firm to estimate, at minimum cost, the average television-viewing time with a bound on the variance equal to 1 hour.

(h) If the advertising firm only has \$500 to spend on sampling, choose the sample size and the allocation that minimizes $\text{Var}(\bar{y}_{ST})$.

(i) The advertising firm decides to use telephone interviews instead of door-to-door so that the costs are now the same for all three strata. Find the Neyman allocation of the sample in this case.

(j) The advertising firm wishes to conduct a new survey (say, next year) to estimate the proportion of households viewing show X, but does not believe their previous results are applicable in this instance. They believe that the proportion is close to 0.4 in each stratum. The firm decides to estimate the population proportion with a bound of 0.1 on the error of estimation. Find the sample size n and the allocation that gives this bound at a minimum cost.