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1. **Project 1: Design a Single-stage Personnel Survey**

Our primary goal is to equip survey researchers with the tools needed to design and weight survey samples. This chapter gives the first of several projects that mirror some of the complexities that are found in applied work. The task here is to determine the allocation of a single-stage sample to strata in a multipurpose survey. As you proceed through the following chapters in Part I of the book, we suggest that you return to this chapter periodically, refresh your memory about the aims of Project 1, and think about how the methods in Chapters 3-6 can be used in the development of the sampling design.

* 1. **Specification for the Study**

The Verkeer NetUltraValid (VNUV) Corporation is preparing to conduct its bi-annual climate survey of employees in their Survey Division. The climate survey assesses employee satisfaction in various areas such as day-to-day work life, performance evaluations, and benefits. The VNUV Senior Council has decided to administer the intranet survey only to a random sample of employees within the Survey Division because this division has hired a large number of new employees over the past two years. The Senior Council requires a report from your design team that specifies the total number of employees to be selected, as well as their distribution by the important characteristics noted below. The Senior Council wishes the quality and precision of the estimates to be the same or better than the last survey.

Three business units are contained in the Survey Division: (*i*) the Survey Research Unit (SR) houses both survey statisticians and survey methodologists; (*ii*) the Computing Research Unit (CR) contains programmers who support analytic and data collection tasks; and (*iii*) Field Operations (FO) is populated by data collection specialists. The Senior Council would like to assess the climate within and across the units, as well as estimates by the three major salary grades (A1-A3, R1-R5, and M1-3) and by tenure (i.e., number of months employed) within the units. However, the climate survey will only be administered to full- and part-time employees within these units. Temporary employees and contractors are excluded from the survey.

The Senior Council has identified three questions from the survey instrument that are most important to assessing the employee climate at VNUV. They are interested in the percentages of employees answering either “strongly agree” or “agree” to the following questions:

Q5. Overall, I am satisfied with VNUV as an employer at the present time.

Q12. There is a clear link between my job performance and my pay at VNUV.

Q15. Overall, I think I am paid fairly compared with people in other organizations who hold jobs similar to mine.

Note that the response options will remain the same as in previous years. Namely, a five-level Likert scale: Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree. A sixth response option, Don’t know/Not Applicable, is also available.

Additionally, the Senior Council would like estimates of the average number of training classes attended by the employees in the past 12 months. Relevant classes include lunch-time presentations, formal instructional classes taught at VNUV, and semester-long courses taught at the local universities.

* 1. **Questions Posed by the Design Team**

After receiving the study specifications document from the Senior Council, a design team is convened to discuss the steps required to complete the assigned task. At this initial meeting, the following information was determined from the specifications in the document.

* Data will be collected from employees through a self-administered intranet (i.e., Web site internal to the corporation) questionnaire.
* All full- and part-time employees in the three business units within the Survey Division are eligible for the survey. Employees in other units within VNUV, as well as temporary employees and contractors, are ineligible and will be excluded from the sampling frame.
* The sample of participants will be randomly selected from a list of all study-eligible employees provided by the head of VNUV’s Human Resources (HR) Department.
* A single-stage stratified sampling design is proposed for the survey because (*i*) study participants can be selected directly from the complete HR (list) sampling frame, and (*ii*) estimates are required for certain groups of employees within VNUV.
* The stratifying variables will include *business unit* (SR, CR, and FO), *salary grade* (A1-A3, R1-R5, and M1-M3), and potentially a categorized version of *tenure*.
* The analysis variables used to determine the allocation include three proportions, corresponding to each of the identified survey questions, and one quantitative variable. Estimates from the previous climate survey will be calculated by the team from the analysis data file maintained by HR.

Based on the initial discussion, the design team submitted the following clarifying questions to the Senior Council and received the responses noted below each.

1. Currently, HR defines tenure as the number of months of employment at VNUV. Is there a grouping of tenure years that would be informative to the analysis? For example, analysis of the previous climate survey suggests that responses differ among employees with less than 5 years of employment at VNUV in comparison to those with a longer tenure.

Response: *Yes. Dichotomize tenure by less than 5 years and 5 years or greater.*

1. What is the budget for the climate survey?

Response: *The climate survey has sufficient funds to include approximately the same number of Survey Division employees as the last round of the survey.*

1. We are interested in classifying a difference between two estimates as being substantively meaningful. Could you provide us with a meaningful difference?

Response: *At least a five percentage point difference between any two sets of estimates is a meaningful difference.*

1. Should the proportion answering “strongly agree” or “agree” to the three questions include or exclude the “don’t know/not applicable” response category?

Response: *Exclude.*

1. How precise should individual estimates be for this round of the survey? The quality of the data from prior versions of the climate survey has been measured in terms of estimated coefficients of variation.

Response: *At least as precise as the estimates from the last survey, however precision was defined there.*

1. Are there additional requirements for the design, such as estimates by gender, by number of dependents, etc. in addition to estimates by business unit, business unit by salary grade, and business unit by tenure?

Response: *No.*

* 1. **Preliminary Analysis**

HR provided the team with two data files. The first file contained information on all current VNUV employees such as name, division, business unit, tenure in months, part-time/full-time status, and temporary/permanent employee status. The team eliminated all records for employees currently known to be ineligible for the survey, created a dichotomized version of tenure, and calculated the following population counts for the 18 design strata.

**Table 2.1. Distribution of Eligible Employees by Business Unit, Salary Grade, and Tenure:**

**VNUV Climate Survey Cycle 8, Survey Division**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **Business Unit** | | |  |
| **Salary Grade** | **Tenure** | **SR** | **CR** | **FO** | **Total** |
| A1-A3 | Less than 5 Years | 28 | 86 | 200 | 314 |
|  | 5+ Years | 40 | 42 | 100 | 182 |
| R1-R5 | Less than 5 Years | 96 | 36 | 280 | 412 |
|  | 5+ Years | 230 | 40 | 118 | 388 |
| M1-M3 | Less than 5 Years | 70 | 12 | 40 | 122 |
|  | 5+ Years | 40 | 28 | 40 | 108 |
| A1-A3 | *Total* | 68 | 128 | 300 | 496 |
| R1-R5 | *Total* | 326 | 76 | 398 | 800 |
| M1-M3 | *Total* | 110 | 40 | 80 | 230 |
| *Total* | Less than 5 Years | 194 | 134 | 520 | 848 |
|  | 5+ Years | 310 | 110 | 258 | 678 |
| *Total* | *Total* | 504 | 244 | 778 | 1526 |

The second file contained one record for each employee selected for the previous climate survey. In addition to the survey status codes (ineligible, eligible respondent, and eligible nonrespondent) and the survey responses, this file included the characteristics noted for the sampling frame with the exclusion of employee name to maintain the confidentiality promised to all survey participants. Sample members were classified as ineligible if, for example, they had transferred to another business unit within VNUV or retired after the sample was selected but before the survey was administered. The team isolated the Survey Division records, created the sampling strata defined for the current climate survey design, and created the binary analysis variables with the following specifications for Q5, Q12, and Q15:

**Table 2.2. Documentation for Recode of Question Responses to Binary Analysis Variable:**

**VNUV Climate Survey Cycle 8, Survey Division**

|  |  |
| --- | --- |
| **Question Responses** | **Binary Analysis Variable** |
| 1 = Strongly Agree | 1 = Strongly Agrees or Agrees |
| 2 = Agree | 1 = Strongly Agrees or Agrees |
| 3 = Neutral | 0 = Does not (Strongly) Agree |
| 4 = Disagree | 0 = Does not (Strongly) Agree |
| 5 = Strongly Disagree | 0 = Does not (Strongly) Agree |
| 6 = Don’t know/Not Applicable | < missing category > |

The total number of respondents from the previous climate survey was 500. This number will be used as a maximum sample size for the new climate survey (*see response to question 2*). The information in Tables 2.3-2.6 was tabulated from the Survey Division records for the previous, Cycle 7 survey.

**Table 2.3. Distribution of Response Status by Business Unit, Salary Grade, and Tenure:**

**VNUV Climate Survey Cycle 7, Survey Division**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **Total** |  |  | **Eligible** | | | | |
| **Business** | **Salary** |  | **Sample** | **Ineligible** | | **Total** | **Respondent** | | **Nonrespondent** | |
| **Unit** | **Grade** | **Tenure** | **n** | **n** | **pct** | **n** | **n** | **pct** | **n** | **pct** |
| SR | A1-A3 | Less than 5 Years | 9 | 0 | 0.0% | 9 | 8 | 88.9% | 1 | 11.1% |
|  |  | 5+ Years | 13 | 0 | 0.0% | 13 | 11 | 84.6% | 2 | 15.4% |
|  | R1-R5 | Less than 5 Years | 31 | 3 | 9.7% | 28 | 16 | 57.1% | 12 | 42.9% |
|  |  | 5+ Years | 75 | 1 | 1.3% | 74 | 59 | 79.7% | 15 | 20.3% |
|  | M1-M3 | Less than 5 Years | 23 | 0 | 0.0% | 23 | 21 | 91.3% | 2 | 8.7% |
|  |  | 5+ Years | 13 | 2 | 15.4% | 11 | 11 | 100.0% | 0 | 0.0% |
| CR | A1-A3 | Less than 5 Years | 28 | 2 | 7.1% | 26 | 8 | 30.8% | 18 | 69.2% |
|  |  | 5+ Years | 14 | 1 | 7.1% | 13 | 7 | 53.8% | 6 | 46.2% |
|  | R1-R5 | Less than 5 Years | 12 | 0 | 0.0% | 12 | 6 | 50.0% | 6 | 50.0% |
|  |  | 5+ Years | 13 | 0 | 0.0% | 13 | 7 | 53.8% | 6 | 46.2% |
|  | M1-M3 | Less than 5 Years | 4 | 0 | 0.0% | 4 | 4 | 100.0% | 0 | 0.0% |
|  |  | 5+ Years | 9 | 1 | 11.1% | 8 | 8 | 100.0% | 0 | 0.0% |
| FO | A1-A3 | Less than 5 Years | 66 | 20 | 30.3% | 46 | 26 | 56.5% | 20 | 43.5% |
|  |  | 5+ Years | 33 | 0 | 0.0% | 33 | 13 | 39.4% | 20 | 60.6% |
|  | R1-R5 | Less than 5 Years | 92 | 2 | 2.2% | 90 | 60 | 66.7% | 30 | 33.3% |
|  |  | 5+ Years | 39 | 1 | 2.6% | 38 | 28 | 73.7% | 10 | 26.3% |
|  | M1-M3 | Less than 5 Years | 13 | 0 | 0.0% | 13 | 13 | 100.0% | 0 | 0.0% |
|  |  | 5+ Years | 13 | 2 | 15.4% | 11 | 11 | 100.0% | 0 | 0.0% |
| Total |  |  | 500 | 35 | 7.0% | 465 | 317 | 68.2% | 148 | 31.8% |

**Table 2.4. Estimates for Four Key Questions by Business Unit, Salary Grade, and Tenure:**

**VNUV Climate Survey Cycle 7, Survey Division**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Business**  **Unit** | **Salary**  **Grade** |  | **Proportion (Strongly) Agree** *a* | | | **Avg Number of Classes** *a* | |
| **Tenure** | **Q5** | **Q12** | **Q15** | **Mean** | **SE** *b* |
| SR | A1-A3 | Less than 5 Years | 0.93 | 0.88 | 0.77 | 8.2 | 0.82 |
|  |  | 5+ Years | 0.75 | 0.71 | 0.62 | 12.4 | 1.24 |
|  | R1-R5 | Less than 5 Years | 0.84 | 0.80 | 0.69 | 22.3 | 2.23 |
|  |  | 5+ Years | 0.80 | 0.76 | 0.66 | 24.0 | 1.92 |
|  | M1-M3 | Less than 5 Years | 0.91 | 0.86 | 0.75 | 8.3 | 0.83 |
|  |  | 5+ Years | 0.95 | 0.90 | 0.79 | 3.6 | 0.36 |
| CR | A1-A3 | Less than 5 Years | 0.99 | 0.94 | 0.92 | 7.2 | 0.72 |
|  |  | 5+ Years | 0.80 | 0.76 | 0.74 | 10.9 | 1.09 |
|  | R1-R5 | Less than 5 Years | 0.82 | 0.78 | 0.76 | 19.6 | 1.96 |
|  |  | 5+ Years | 0.90 | 0.86 | 0.84 | 21.1 | 2.11 |
|  | M1-M3 | Less than 5 Years | 0.97 | 0.92 | 0.90 | 7.3 | 0.73 |
|  |  | 5+ Years | 0.97 | 0.92 | 0.90 | 3.2 | 0.32 |
| FO | A1-A3 | Less than 5 Years | 0.50 | 0.48 | 0.45 | 4.6 | 0.37 |
|  |  | 5+ Years | 0.52 | 0.49 | 0.47 | 6.9 | 0.56 |
|  | R1-R5 | Less than 5 Years | 0.75 | 0.71 | 0.68 | 12.5 | 1.00 |
|  |  | 5+ Years | 0.70 | 0.67 | 0.63 | 13.4 | 1.08 |
|  | M1-M3 | Less than 5 Years | 0.93 | 0.88 | 0.84 | 4.6 | 0.46 |
|  |  | 5+ Years | 0.94 | 0.89 | 0.85 | 2.0 | 0.20 |
| *a Estimates calculated using analysis weights and accounting for the sampling design.*  *b  Standard error.* | | | | | | | |

**Table 2.5. Estimates By Reporting Domain: VNUV Climate Survey Cycle 7, Survey Division**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Business**  **Unit** | **Salary**  **Grade** | **Tenure** | **Proportion (Strongly) Agree** | | | **Avg Number of Classes** *a* | |
| **Q5** | **Q12** | **Q15** | **Mean** | **SE** *b* |
| SR |  |  | 0.84 | 0.80 | 0.69 | 18.1 | 0.97 |
| CR |  |  | 0.91 | 0.87 | 0.85 | 11.5 | 0.31 |
| FO |  |  | 0.67 | 0.63 | 0.60 | 8.9 | 0.17 |
| SR | A1-A3 |  | 0.82 | 0.78 | 0.68 | 10.7 | 0.65 |
|  | R1-R5 |  | 0.81 | 0.77 | 0.67 | 23.5 | 2.27 |
|  | M1-M3 |  | 0.92 | 0.88 | 0.76 | 6.6 | 0.30 |
| CR | A1-A3 |  | 0.93 | 0.88 | 0.86 | 8.4 | 0.36 |
|  | R1-R5 |  | 0.86 | 0.82 | 0.80 | 20.4 | 2.10 |
|  | M1-M3 |  | 0.97 | 0.92 | 0.90 | 4.4 | 0.10 |
| FO | A1-A3 |  | 0.51 | 0.48 | 0.46 | 5.4 | 0.09 |
|  | R1-R5 |  | 0.74 | 0.70 | 0.66 | 12.8 | 0.60 |
|  | M1-M3 |  | 0.94 | 0.89 | 0.84 | 3.3 | 0.06 |
| SR |  | Less than 5 Years | 0.88 | 0.83 | 0.73 | 15.2 | 1.32 |
|  |  | 5+ Years | 0.81 | 0.77 | 0.67 | 19.9 | 2.06 |
| CR |  | Less than 5 Years | 0.94 | 0.90 | 0.88 | 10.6 | 0.50 |
|  |  | 5+ Years | 0.88 | 0.84 | 0.82 | 12.7 | 0.77 |
| FO |  | Less than 5 Years | 0.67 | 0.63 | 0.60 | 8.8 | 0.31 |
|  |  | 5+ Years | 0.67 | 0.63 | 0.60 | 9.2 | 0.29 |
| *a Estimates calculated using analysis weights and accounting for the sampling design.*  *b  Standard error.* | | | | | | | |

**Table 2.6. Target Coefficient of Variation by Reporting Domain:**

**VNUV Climate Survey Cycle 7, Survey Division.**

|  |  |
| --- | --- |
| **Reporting Domain** | **Target CV** |
| Business Unit | 0.08 |
| Unit × Salary Grade | 0.12 |
| Unit × Tenure | 0.12 |

* 1. **Next Steps**

The optimization problem and a proposed solution to the sampling design task discussed in this chapter will be revealed in Chapter 7. The methods discussed in subsequent chapters in Part I (i.e., Chapters 3-6) will provide you with the tools to solve the allocation problem yourself. We will periodically revisit the VNUV design team discussions prior to Chapter 7 to provide insight into their decisions and procedures.