Estimation Considerations for the Occupational Requirements Survey

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Abstract
The Bureau of Labor Statistics (BLS) is working with the Social Security Administration (SSA) to carry out a series of tests to determine the feasibility of using the National Compensation Survey (NCS) platform to accurately and reliably capture data that are relevant to the SSA's disability program. The proposed new Occupational Requirements Survey (ORS) is envisioned to be an establishment survey that collects information on the vocational preparation and the cognitive and physical requirements of occupations in the U.S. economy, as well as the environmental conditions in which those occupations are performed. Many of the data elements are collected on the basis of presence and then are measured by duration (length of time). Some data elements collected are conditional on the presence of another data element. This paper discusses the considerations for developing the estimates to be produced for ORS and how the micro data may be adjusted to account for unit and item non-response.

Key Words: estimation, binomial data, point estimates, establishment survey, descriptive statistics

1. Introduction

In the summer of 2012, the Social Security Administration (SSA) and the Bureau of Labor Statistics (BLS) signed an interagency agreement to begin the process of testing the collection of data on occupations. As a result, the Occupational Requirements Survey (ORS) began testing in late 2012. The goal of ORS is to collect and publish occupational information that will replace the outdated data currently used by SSA. All ORS products will be made public for use by non-profits, employment agencies, state or federal agencies, the disability community, and other stakeholders. More information on the background of ORS can be found in the next section.

An ORS interviewer attempts to collect close to 70 data elements related to the occupational requirements of a job. The following four groups of information will be collected:

- Physical demand characteristics/factors of occupations (e.g. strength, hearing, or stooping)
- Educational requirements
- Cognitive elements required to perform work
- Environmental conditions in which the work is completed

During the last two years of survey testing, there have been a number of changes to the details of collection. Some data elements were not considered necessary and were dropped. New data elements were added to the list. Many data element definitions were refined, while continuing to rely on definitions from the Revised Handbook for Analyzing Jobs (RHAJ) [1]. In some cases, the method of collection was changed. For instance, initially the duration of an occupational activity was captured categorically using ranges of time defined by SSA. Currently duration is captured by hours or percentage of the day, with fallbacks being a range specified by the respondent or use of a duration scale.

This paper explores the estimation and some of the non-response options for ORS data. Section 2 provides background information on the Occupational Requirements Survey. Section 3 explains the types of ORS data elements captured and available for use in estimation. Section 4 explores the estimation possibilities for each data element, and Section 5 provides a glimpse of some non-response adjustment possibilities. The paper ends with a conclusion and description of further research to be completed.

2. Background Information on ORS

In addition to providing Social Security benefits to retirees and survivors, the Social Security Administration (SSA) administers two large disability programs, which provide benefit payments to millions of beneficiaries each year. Determinations for adult disability applicants are based on a five-step process that evaluates the capabilities of workers, the requirements of their past work, and their ability to perform other work in the U.S. economy. In some cases, if an applicant is denied disability benefits, SSA policy requires adjudicators to document the decision by citing examples of jobs the claimant can still perform despite restrictions (such as limited ability to balance, stand, or carry objects) [2].

For over 50 years, the Social Security Administration has turned to the Department of Labor's Dictionary of Occupational Titles (DOT) [3] as its primary source of occupational information to process the disability claims [4]. SSA has incorporated many DOT conventions into their disability regulations. However, the DOT was last updated in its entirety in the late 1970's, although a partial update was completed in 1991. Consequently, the SSA adjudicators who make the disability decisions must continue to refer to an increasingly outdated resource because it remains the most compatible with their statutory mandate and is the best source of data at this time.

When an applicant is denied SSA benefits, SSA must sometimes document the decision by citing examples of jobs that the claimant can still perform, despite their functional limitations. However, since the DOT has not been updated for so long, there are some jobs in the American economy that are not even represented in the DOT, and other jobs, in fact many often-cited jobs, no longer exist in large numbers in the American economy. For example, a job that is often cited is "envelope addressor," because it is an example of a low-skilled job from the DOT with very low physical demands. There are serious doubts about whether or not this job still exists in the economy.

SSA has investigated numerous alternative data sources for the DOT such as adapting the Employment and Training Administration's Occupational Information Network (O*NET) [5], using the BLS Occupational Employment Statistics program [6] (OES), and developing their own survey. But SSA was not successful with any of these potential data

sources and turned to the National Compensation Survey program at the Bureau of Labor Statistics.

3. Captured Data Elements

ORS is designed to capture occupational information on educational requirements, cognitive and physical demands, and exposures to environmental conditions. Each of the data elements falls into two data types: categorical and continuous. Data elements that are categorical have a set of predetermined values, one of which will be selected as a response. Continuous data may be limited by a minimum, such as zero hours, or a maximum, such as 100 percent.

Educational requirements are part of a category called "Specific Vocational Preparation" (SVP). SVP measures the amount of time it takes a typical worker to learn the techniques and acquire the information needed for average job performance. There are four components:

1. Minimum level of education, including literacy
2. Previous job experience required
3. Time spent in earning certifications and licenses (pre- or post-employment training)
4. On-the-job training (expressed as the time to average performance).

Level of education is measured by the receipt of a degree, and an amount of time is assigned based on the degree. The four components are used to identify the following three occupational requirements, listed in Tables 1-3 below, desired by the SSA.

Table 1: Specific Vocational Preparation

SVP Level	Amount of Specific Vocational Preparation Time
1	Short demonstration only
2	Anything beyond short demonstration up to and including 1 month
3	Over 1 month up to and including 3 months
4	Over 3 months up to and including 6 months
5	Over 6 months up to and including 1 year
6	Over 1 year up to and including 2 years
7	Over 2 years up to and including 4 years
8	Over 4 years up to and including 10 years
9	Over 10 years

Table 2: Job Zone

Job Zone	Preparation Level	SVP Level(s)
1	Little or no preparation needed	1-3
2	Some preparation needed	4-5
3	Medium preparation needed	6
4	Considerable preparation needed	7
5	Extensive preparation needed	8-9

Table 3: Skill Level

Skill Level	SVP Levels
Unskilled	1-2
Semi-skilled	3-4
Skilled	5-9

Cognitive abilities are captured entirely in categories. Information is gathered about the complexity of the job, the amount of oversight and controls associated with the job, the occurrence of deviations in work tasks, work schedules, and work location as well as the types and frequency of personal interactions required to perform typical job duties.

The job complexity data element measures the level of decision-making, comprehension, memory, and application of information needed to perform the typical duties of an occupation. Work controls refer to the level of supervision and requirement for workers to adhere to established guidelines. Several data elements measure the work routine of an occupation, including the deviation in tasks, work schedule, and work location. Finally, the cognitive data elements explore the type and frequency of worker communications with established working relationships, labeled regular contacts, and other contacts.

Table 4 summarizes the cognitive data elements and possible responses.

Table 4: Cognitive Data Element Responses

Cognitive Measure	Possible Response
How complicated are the tasks of the occupation?	Very simple, simple, moderate, complex, very complex
How closely controlled is the occupation's work?	Very closely, closely, moderately, loosely, very loosely
How often are there deviations from the norm in work tasks?	Hourly, daily, weekly, monthly, less than monthly
How often are there deviations from the norm in work schedule?	Hourly, daily, weekly, monthly, less than monthly
How often are there deviations from the norm in work location?	Hourly, daily, weekly, monthly, less than monthly
How often does the occupation verbally interact (work related) with regular contacts?	Hourly, daily, weekly, monthly, less than monthly
What type of work-related interactions does the occupation have with regular contacts?	Very structured, structured, semi-structured, unstructured, very unstructured
How often does the occupation verbally interact (work related) with people other than regular contacts?	Hourly, daily, weekly, monthly, less than monthly
What type of work-related interactions does this occupation have with people other than regular contacts?	Very structured, structured, semi-structured, unstructured, very unstructured

Physical demands are captured in two ways: presence and duration. A physical demand is considered present if the worker is required to perform an activity as part of the job. Duration measures the amount of time in a typical work day a worker spends performing a physical demand. Some physical demands will only have information on presence, such as the demands for hearing or vision. The full list of physical demands is as follows:

- Sitting
- Standing/Walking
- Sitting vs. Standing at Will
- Lifting/Carrying
- Reaching (overhead and at or below the shoulder)
- Pushing and pulling with arms, legs, or feet only
- Climbing stairs and ramps (job related or structural)
- Climbing ladders and scaffolds
- Crouching, kneeling, crawling, stooping
- Use of hands (gross manipulation)
- Use of fingers (fine manipulation)
- Use of one or both feet or legs to move controls on machinery or equipment

- Keyboarding (10-key, traditional, touch screen, other)
- Hearing
- Vision (near/far acuity, peripheral)
- Driving and Vehicle Type
- Communicating verbally (one-on-one, group, telephone, or other sounds)

Some physical demands have sub-questions. One example is the reaching data element. Once reaching is found to be present and a duration is captured, an additional piece of information is collected: does the reaching require one arm or both arms? Other physical demands that have sub-questions include pushing and pulling, use of hands, and use of fingers. An example for reaching is found in Table 5.

Table 5: Reaching with one or both arms

Data Element	**Response**
Reaching	2 hours
One arm or both arms	One arm

Lifting and carrying weight is an exception. One data element measures the maximum amount a worker would have to lift and/or carry. After determining the most that a worker would have to lift, the amount of weight being lifted within a certain duration, such as between one-third and two-thirds of the time, would be captured. SSA uses the categories in Table 6, most of which are defined by the RHAJ [1].

Table 6: SSA Categories for Lifting and Carrying Weight

How Often	**Ranges for Amount of Weight**				
Never	None	None	None	None	None
Seldom (not in the RHAJ)	0 to 10 lbs	11 to 20 lbs	21 to 50 lbs	51 to 100 lbs	More than 100 lbs
Up to 1/3 of the time	0 to 10 lbs	11 to 20 lbs	21 to 50 lbs	51 to 100 lbs	More than 100 lbs
1/3 up to 2/3 of the time	Negligible	0 to 10 lbs	11 to 25 lbs	26 to 50 lbs	More than 50 lbs
2/3 of the time or more	None	Negligible	0 to 10 lbs	11 to 20 lbs	More than 20 lbs

One other physical demand data element measures the strength required for a job. This data element incorporates the amount of weight a worker must lift, push, and/or pull. Currently, the weight thresholds for each category of the strength data element are still under development.

Environmental conditions are the specific surroundings and circumstances in which an occupation is typically performed. Data are captured on eleven environmental conditions. Ten such conditions are captured by presence and duration. Exposure should be coded as experienced with the use of personal protective equipment. Environmental conditions data are collected for the amount of time a worker is exposed to:

- Outdoors
- Humidity
- Extreme heat
- Extreme cold
- Heavy vibration
- High, exposed places
- Wetness
- Proximity to moving parts
- Toxic, caustic chemicals
- Fumes, noxious odors, dusts, gases

The eleventh environmental condition is noise intensity level. This condition is captured in four categories - quiet, moderate, loud, and very loud - considering the job's typical noise intensity exposure and accounting for any protective equipment.

4. Estimation Possibilities

Estimation options will depend on the type of data element. For any categorical data element, a percentage of workers that fall into a given category could be calculated. For continuous data elements, descriptive statistics could be calculated, including the mean amount of time and percentiles. If the continuous data were placed within pre-specified ranges, they would become categorical values, and percentages could be calculated. Table 7 presents the many of the ORS data elements and respective estimation possibilities.

Table 7: Sample ORS Data Elements and Possible Estimates

ORS Data Element	Percentage	Mean	Percentile
Cognitive Data Elements	x		
Environmental Conditions	x		
Education (high school, bachelor's degree, …)	x		
Certifications, license, and training		x	x
Post-employment training		x	x
Previous Experience		x	x
Lifting and Carrying	x	x	x
Climbing Ladders/Ropes/Scaffolds	x	x	x
Climbing Ramps/Stairs	x	x	x
Crawling, crouching, stooping, kneeling	x	x	x
Driving	x		
Near/far Visual Acuity	x		
Use of fingers	x	x	x
Use of hands	x	x	x
Hearing	x		
Keyboarding (10-key)	x	x	x
Keyboarding (Other)	x	x	x
Keyboarding (Touch Screen)	x	x	x
Keyboarding (Traditional)	x	x	x
Peripheral Vision	x		
Pushing/Pulling with Foot/Leg	x	x	x
Pushing/Pulling with Hand/Arm	x	x	x
Reaching from the Shoulder	x	x	x
Reaching Overhead	x	x	x
Sitting		x	x
Standing		x	x

Table 8 presents SSA's requested categories for the duration of any activity or exposure.

Table 8: SSA Duration Categories

SSA Duration Category	Activity/Exposure Occurrence in a Work Day
Not Present	Not present
Seldom	Occurs less than 2% of the time
Occasionally	Occurs 2% to less than 1/3 of the time
Frequently	Occurs 1/3 to less than 2/3 of the time
Constantly	Occurs 2/3 of the time or more

For data elements that could be expressed as a category (see Table 7), a percentage of workers for whom the element is present will be calculated for each category among the total number of workers.

The percentage will be calculated over some specified domain, such as an occupation, an occupation within an industry, or a group of occupations. The formula for the percentage of workers in the domain is as follows.

$$\frac{\left[\sum_{i=1}^{I}\sum_{g=1}^{G_i} \mathrm{OccFW}_{ig} \times X_{ig} \times Z_{ig}\right]}{\left[\sum_{i=1}^{I}\sum_{g=1}^{G_i} \mathrm{OccFW}_{ig} \times X_{ig}\right]} \times 100$$

where:

i = Establishment

I = Total number of establishments

g = Occupational quote within establishment i

G_i = Total number of occupational quotes in establishment i

OccFW_{ig} = Final occupational quote weight (a weight denoting the number employees in the frame that are represented by occupation g in establishment i) for occupation g in establishment i

X_{ig} = 1 if occupational quote ig is in the domain
= 0 otherwise

Z_{ig} = 1 if the data element is present for occupational quote ig
= 0 otherwise

To calculate the percentage of employees for whom a data element is present out of all employees in the domain, add the final quote weights across only those occupational quotes in the domain for whom the data element is present. Then divide that number by the sum of the final quote weights across quotes in the domain. Multiply the final quotient by 100 to yield a percentage estimate.

An example of a percentage estimate follows. Each estimate will have an associated measure of error. Calculation of standard errors will be left for a future paper.

Example 1: Education Level for Salespersons

Education Level	% of workers	Standard Error
High School	15%	3%
Associates	8%	2%
Bachelors	47%	4%
…		

Some data elements depend on the presence of a related data element. For instance, as noted above, once an occupation is known to require reaching overhead, an additional question captures whether the job requires the worker to reach overhead with one hand or with both hands. All of these circumstances necessitate a calculation of a percentage. A complete list of such data elements follows.

- Reaching overhead
- Reaching from the shoulder
- Pushing or pulling
- Use of hands

The following example illustrates a sub-category of the reaching data element. Once the presence of reaching has been established for a particular occupation, a follow-up question records whether the reaching can be done with one hand/arm only, or if reaching with both hands/arms is necessary. In the example below, of the 75% of workers required to reach overhead, 20% could perform the reaching with one hand or arm.

Example 2: Presence of Reaching Overhead for Salespersons

Reaching Overhead	% of workers	Standard Error
Not present	25%	3%
Present	75%	2%
With one hand/arm	20%	1%
With both hands/arms	80%	2%

Finally, a number of data elements are captured as continuous data. Mean and percentile values will be calculated for all continuous data elements (see Table 7). In addition, some continuous data will be converted into a range for use by SSA. These ranges will act as categories and a percentage of workers will be calculated, as described earlier for categorical data.

A mean for a data element will be calculated over some specified domain, such as an occupation, and the formula is as follows:

$$\frac{\left[\sum_{i=1}^{I}\sum_{g=1}^{G_i}\mathrm{OccFW}_{ig}\times X_{ig}\times Z_{ig}\times Q_{ig}\right]}{\left[\sum_{i=1}^{I}\sum_{g=1}^{G_i}\mathrm{OccFW}_{ig}\times X_{ig}\times Z_{ig}\right]}$$

where:

i	= Establishment
I	= Total number of establishments in the survey
g	= Occupational quote within establishment i
G_i	= Total number of occupational quotes in establishment i
OccFW_{ig}	= Final quote weight for occupation g in establishment i
X_{ig}	= 1 if occupational quote ig is in the domain = 0 otherwise
Z_{ig}	= 1 if the data element is present for occupational quote ig = 0 otherwise
Q_{ig}	= Value of the continuous data element for occupational quote ig

To calculate the mean value of a continuous data element, multiply the final quote weight and the value of the element for those occupational quotes in the domain for whom the element is present; add these values across all contributing quotes to create the numerator. Divide this number by the sum of the final quote weights across only those quotes in the domain for whom the element is present.

The following percentiles, designated as p, would be calculated: 10^{th}, 25^{th}, 50^{th} (median), 75^{th} and 90^{th}. The p-th percentile is the value of the continuous data element Q_{ig} such that:

- the sum of final occupational quote weights (OccFW_{ig}) across quotes with a value less than Q_{igj} is less than p percent of all final quote weights, and
- the sum of final occupational quote weights (OccFW_{ig}) across quotes with a value more than Q_{igj} is less than (100 – p) percent of all final quote weights.

It is possible that there are no specific quotes ig for which both of these properties hold. This occurs when there exists a quote for which the OccFW_{ig} of records whose value is less than Q_{ig} equals p percent of all final quote weights. In this situation, the p-th percentile is the average of Q_{ig} and the value on the record with the next lowest value. Include only occupational quotes in the domain for whom the element is present – i.e., where:

$$X_{ig}\times Z_{ig}=1$$

where:

X_{ig} = 1 if occupational quote ig is in the domain
= 0 otherwise

Z_{ig} = 1 if the data element is present for occupational quote ig
= 0 otherwise

i = Establishment

g = Occupational quote within establishment i

5. Initial Non-response Adjustment Ideas

Both unit and item non-response are expected to occur in the collection of the Occupational Requirements Survey. Unit non-response would entail a sampled establishment or occupation refusing to provide ORS data, while item non-response would refer to incomplete information within an occupation about the data elements described in the earlier sections.

There is not much information on the expected amount of unit non-response for ORS at this point. Each of the various survey tests to this point have been focused on collection feasibility and protocols. ORS interviewers collected data from cooperating establishments found on an over-sampled list of units that was not fully representative of the sample frame. Notes detailing the reasons for refusal were taken for feasibility tests occurring in 2014, but refusal turnaround was not attempted. Additionally, ORS interviewers were not limited to a strict probability selection of occupations within an establishment but, instead, could collect data on occupations at the convenience of the respondent. However, completing a probability selection of establishments and occupations is vital for a statistically sound survey and so, generally, the additional respondent burden will result in increased non-response.

Similar to the National Compensation Survey (NCS) [7], ORS plans to adjust for unit non-response by re-weighting establishments and occupations within a pre-specified non-response adjustment cell. Once a weighting adjustment has been made to the establishments and occupations within a cell where a unit refused, the weights of all viable units may be further adjusted by benchmarking the weights to the current national employment to obtain the Occupational Final Quote Weight used in the formulas above.

Early testing of ORS has shown a low instance of item non-response. Once an establishment cooperates in collection, nearly all information for all items and quotes was collected in a single appointment. However, these circumstances are considered unusual as ORS interviewers will be attempting collection from less cooperative establishments in a production environment. As a result, some methods must be developed to alleviate the impending item non-response as ORS moves into production.

One option currently under investigation is to group similar ORS data elements and impute all items in a group where at least one item is missing. The data elements naturally split into several imputation groups, though some groups are larger than others. For instance, all of the data elements regarding the lifting and carrying of weight could appear in an

imputation group. Using groups may help keep imputed responses consistent with collected responses. Also, having a small number of elements within imputation groups would be ideal as less collected data would be over-written in the process of imputing for a single missing value within a group. Imputation could employ the nearest neighbor approach, where the nearest neighbor is determined by the establishment employment size. Imputation cells may need to be collapsed for situations where a cell lacks a viable number of donors. Further research on item non-response will occur in the next phase of survey testing.

6. Conclusion and Next Steps

Estimation for ORS data will likely include the use of descriptive statistics, dependent on whether the data element type is categorical or continuous. Some data element estimates are dependent on the presence of another data element. Percentages of workers in a category will be calculated for categorical data; the mean amount of time and percentiles will be calculated for continuous data. Standard errors, while not discussed in this paper, will accompany all estimates of percentages, means, and percentiles.

While non-response is expected to be present in ORS, there are currently no final procedures for non-response adjustment. The behavior of ORS data is largely unknown and must be studied further. As a starting point, unit-level non-response will be adjusted for by adjusting the weights of both establishments and occupations. Possible methods for item non-response adjustment are under review. Before the production of estimates from the first full-scale production sample, an imputation method will be tested involving nearest neighbor imputation by employment size and within cell definitions based on available variables. Once a greater amount of ORS data has been amassed, more information will be available for use in developing appropriate item non-response adjustments.

References/Footnotes

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