Creating State Specific Occupational Replacement Rates

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Alex Roubinchtsein
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We produce industry and occupational projections annually for 2, 5 and 10 years for Washington state and 12 Workforce Development Areas (WDAs).

Last year, we used our projections with alternative rates as the basis for the Occupations in Demand (OID) list.
The OID list supports the unemployment insurance Training Benefits (TB) program.

The Washington State Employment Security Department (ESD) also uses the list to determine eligibility for a variety of training and support programs.

The OID list is supplemented by current supply-demand data.
Realistic replacement rates are critical

- Replacement openings create the majority of job openings nationwide and statewide.
- States’ specific economic conditions determine actual replacements.
- Net replacement rates used previously significantly undercut the numbers of openings and are unrealistic.
- The newer separation rates do not represent total openings and are not state specific.
Basic idea

- Use wage files (quarterly unemployment insurance tax returns) to identify replacements and separations within industries.
- Use occupational/industry matrices (staffing patterns) to transfer industry rates to occupations.

**Note:** All calculations for this report (including employment projections) were produced using open source R software.
Pre-processing wage files

- Delete non-valid records.
- Set limits for quarterly work hours between 100 and 1,000. For each SSN, total hours must be less than 1,000.
- Set limits for hourly wages between $8.00 and $1,000.
- We used only one record for each SSN in each quarter. We selected the record with the largest number of work hours and defined it the primary job.
Alternative rates

For each sequential pair of wage files, $w_t$ and $w_{t+1}$, the following characteristics are defined for each industry – the industries of the primary job of the SSNs.

1. For our 2017 projections,
   
   $w_t = 2014Q4$, and $w_{t+1} = 2015Q4$.

2. Base jobs – number of records in an industry in $w_t$. 
3. **Lost jobs** – number of jobs that moved out of an industry. Records in $w_t$ but not in $w_{t+1}$.

4. **New jobs** – number of jobs that moved into an industry. Records in $w_{t+1}$ but not in $w_t$.

5. **Moved-out cross industry matrix** – aggregation by originating industries.

6. **Moved-in cross industry matrix** – aggregation by receiving industries.
7. Industry moves – number of jobs (workers) changing employers but remaining within an industry.
8. Separations = \( \min \) (new jobs, lost jobs)
9. Transfers = Moved-in + Industry moves
10. Total replacements = Separations + Transfers
11. Industry replacement rates (IRR)

\[
\text{IRR} = \frac{\text{Total replacements}}{\text{Base employment}}
\]
Converting industry (IR) to occupation replacements (OR)

- We convert industry replacements to occupations based on the staffing patterns of the occupational/industry matrices.
- In other words, we used occupational shares within an industry – all occupational shares sum to one within each industry.
- For occupational projections, we aggregated the results by industry control total (ICT) codes with base employment in 2014Q4.
Steps for converting IR to OR

1. Aggregate base industry employment, separations, transfers and total replacements to ICT levels.

2. Match aggregated file with staffing patterns file based on ICT codes.

3. Multiply all industry employment, in the new matched file, by shares from occupational/industry matrices.
Steps for converting IR to OR
(continued)

4. Aggregate results by occupational (SOC) codes.

5. Calculate occupational ratios of separations, transfers and total replacements by dividing corresponding values by base employment.
Comparison of different replacement rates

We compared different replacement rates during the 2017 projection cycle using Washington state results.

Definitions:

- Survival time for specific occupations or jobs represents the expected time a worker stays employed in that occupation (job).
Comparison of different replacement rates (continued)

- Average survival time in years (AST):

\[ \text{AST} = \frac{1}{\text{Annual replacement rate}} \]
Comparison of different replacement rate methods

Results of simple average of occupational average survival time (ASTs) – years – among all occupations.

<table>
<thead>
<tr>
<th>Simple average of occupational ASTs (years)</th>
<th>Prior net replacement rate (NRR)</th>
<th>New national separation rate (SR)</th>
<th>Washington state alternative rates (WAar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>52.15</td>
<td>11.52</td>
<td>3.98</td>
<td></td>
</tr>
</tbody>
</table>
Comparison of different replacement rate methods (continued)

Other findings:

- **National net replacement rate (NRR):**
  - \( \text{AST}_{NRR} \) of 45 occupations was more than 100 years – largest was more than 288 years.

- **Examples of \( \text{AST}_{NRR} \) averages:**
  - Register Nurses: 42.38 years
  - Computer Hardware Engineers: 48.67 years
  - Computer Programmers: 40.59 years
Comparison of different replacement rate methods (continued)

- **New national separation rate (SR):**
  - \( \text{AST}_{SR} \) of 15 occupations was more than 30 years – all within the category of Healthcare Practitioners and Technical Occupations.

- **Washington state alternative rate (WAar):**
  - Only 10 occupations had an \( \text{AST}_{WAar} \) of more than eight years – the majority of these within the category of Aerospace and Material Engineering.
  - For computer-related occupations the \( \text{AST}_{WAar} \) was four years.
## Comparison of replacement, separation and alternative rates

### Washington state occupational forecasts, 2015-2025

<table>
<thead>
<tr>
<th>2-digit SOC code</th>
<th>2-digit SOC title</th>
<th>Estimated employment 2015</th>
<th>Estimated employment 2025</th>
<th>Average annual openings due to alternative replacement rates</th>
<th>Ratio separations to replacement</th>
<th>Ratio alternative to separations</th>
</tr>
</thead>
<tbody>
<tr>
<td>00-0000</td>
<td>Totals</td>
<td>3,586,032</td>
<td>4,185,024</td>
<td>1,186,072</td>
<td>4.63</td>
<td>2.86</td>
</tr>
<tr>
<td>11-0000</td>
<td>Management</td>
<td>201,435</td>
<td>241,251</td>
<td>62,357</td>
<td>3.26</td>
<td>3.83</td>
</tr>
<tr>
<td>13-0000</td>
<td>Business and financial operations</td>
<td>216,364</td>
<td>258,769</td>
<td>62,245</td>
<td>4.33</td>
<td>3.1</td>
</tr>
<tr>
<td>17-0000</td>
<td>Architecture and engineering</td>
<td>84,757</td>
<td>86,391</td>
<td>17,676</td>
<td>2.68</td>
<td>3.13</td>
</tr>
<tr>
<td>19-0000</td>
<td>Life, physical and social science</td>
<td>38,477</td>
<td>45,056</td>
<td>9,606</td>
<td>3.17</td>
<td>2.52</td>
</tr>
<tr>
<td>21-0000</td>
<td>Community and social service</td>
<td>59,766</td>
<td>68,084</td>
<td>16,437</td>
<td>4.69</td>
<td>2.53</td>
</tr>
</tbody>
</table>
Comparison of replacement, separation and alternative rates (continued)

**Washington state occupational forecasts, 2015-2025**

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<tbody>
<tr>
<td>23-0000</td>
<td>Legal</td>
<td>28,208</td>
<td>31,777</td>
<td>7,008</td>
<td>3.16</td>
<td>4.3</td>
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<tr>
<td>25-0000</td>
<td>Education, training and library</td>
<td>216,241</td>
<td>261,135</td>
<td>48,283</td>
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<td>2.27</td>
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<tr>
<td>27-0000</td>
<td>Arts, design, entertainment, sports and media</td>
<td>67,708</td>
<td>81,995</td>
<td>22,470</td>
<td>4.09</td>
<td>3.06</td>
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<tr>
<td>29-0000</td>
<td>Healthcare practitioners and technical</td>
<td>167,820</td>
<td>206,639</td>
<td>49,502</td>
<td>2.31</td>
<td>5.29</td>
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<tr>
<td>31-0000</td>
<td>Healthcare support</td>
<td>89,055</td>
<td>108,580</td>
<td>33,071</td>
<td>5.48</td>
<td>2.93</td>
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<tr>
<td>33-0000</td>
<td>Protective service</td>
<td>62,807</td>
<td>72,725</td>
<td>16,518</td>
<td>4.6</td>
<td>2.27</td>
</tr>
<tr>
<td>35-0000</td>
<td>Food preparation and serving related</td>
<td>285,348</td>
<td>324,620</td>
<td>123,260</td>
<td>4.63</td>
<td>2.34</td>
</tr>
<tr>
<td>37-0000</td>
<td>Building and grounds cleaning and maintenance</td>
<td>116,668</td>
<td>139,247</td>
<td>46,505</td>
<td>6.19</td>
<td>2.92</td>
</tr>
</tbody>
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<th>Ratio alternative to separations</th>
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</thead>
<tbody>
<tr>
<td>39-0000</td>
<td>Personal care and service</td>
<td>149,252</td>
<td>179,994</td>
<td>61,450</td>
<td>7</td>
<td>2.59</td>
</tr>
<tr>
<td>41-0000</td>
<td>Sales and related</td>
<td>343,304</td>
<td>383,724</td>
<td>117,860</td>
<td>4.63</td>
<td>2.46</td>
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<tr>
<td>43-0000</td>
<td>Office and administrative support</td>
<td>449,756</td>
<td>512,329</td>
<td>141,337</td>
<td>5.29</td>
<td>2.7</td>
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<tr>
<td>45-0000</td>
<td>Farming, fishing and forestry</td>
<td>93,779</td>
<td>103,178</td>
<td>39,272</td>
<td>5.71</td>
<td>2.69</td>
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<tr>
<td>47-0000</td>
<td>Construction and extraction</td>
<td>199,456</td>
<td>252,989</td>
<td>90,587</td>
<td>6.28</td>
<td>4.25</td>
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<tr>
<td>49-0000</td>
<td>Installation, maintenance and repair</td>
<td>130,739</td>
<td>144,138</td>
<td>41,715</td>
<td>3.88</td>
<td>3.35</td>
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<tr>
<td>51-0000</td>
<td>Production</td>
<td>188,916</td>
<td>195,357</td>
<td>49,492</td>
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<td>2.3</td>
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<tr>
<td>53-0000</td>
<td>Transportation and material moving</td>
<td>227,288</td>
<td>253,692</td>
<td>76,375</td>
<td>4.94</td>
<td>2.64</td>
</tr>
</tbody>
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Comparison of annual average survival time for replacement, separation and alternative rates (in years)

Washington state occupational forecasts, 2015-2025

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<th>2-digit SOC code</th>
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<tr>
<td>00-0000</td>
<td>Totals</td>
<td>43.37</td>
<td>9.38</td>
<td>3.28</td>
</tr>
<tr>
<td>11-0000</td>
<td>Management</td>
<td>44.3</td>
<td>13.6</td>
<td>3.5</td>
</tr>
<tr>
<td>13-0000</td>
<td>Business and financial operations</td>
<td>51.2</td>
<td>11.83</td>
<td>3.82</td>
</tr>
<tr>
<td>15-0000</td>
<td>Computer and mathematical</td>
<td>66.46</td>
<td>16.11</td>
<td>3.79</td>
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<tr>
<td>17-0000</td>
<td>Architecture and engineering</td>
<td>40.64</td>
<td>15.15</td>
<td>4.84</td>
</tr>
<tr>
<td>19-0000</td>
<td>Life, physical and social science</td>
<td>34.63</td>
<td>10.94</td>
<td>4.35</td>
</tr>
<tr>
<td>21-0000</td>
<td>Community and social service</td>
<td>46.11</td>
<td>9.83</td>
<td>3.89</td>
</tr>
<tr>
<td>23-0000</td>
<td>Legal</td>
<td>58.06</td>
<td>18.4</td>
<td>4.28</td>
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<tr>
<td>25-0000</td>
<td>Education, training and library</td>
<td>45.23</td>
<td>11.24</td>
<td>4.94</td>
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<td>27-0000</td>
<td>Arts, design, entertainment, sports and media</td>
<td>41.66</td>
<td>10.18</td>
<td>3.33</td>
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<td>46.2</td>
<td>20.02</td>
<td>3.78</td>
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Comparison of annual average survival time for replacement, separation and alternative rates (in years - continued)

Washington state occupational forecasts, 2015-2025

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<th>Alternative rates</th>
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</thead>
<tbody>
<tr>
<td>31-0000</td>
<td>Healthcare support</td>
<td>47.94</td>
<td>8.75</td>
<td>2.99</td>
</tr>
<tr>
<td>33-0000</td>
<td>Protective service</td>
<td>42.74</td>
<td>9.29</td>
<td>4.1</td>
</tr>
<tr>
<td>35-0000</td>
<td>Food preparation and serving related</td>
<td>26.77</td>
<td>5.78</td>
<td>2.47</td>
</tr>
<tr>
<td>37-0000</td>
<td>Building and grounds cleaning and maintenance</td>
<td>49.67</td>
<td>8.03</td>
<td>2.75</td>
</tr>
<tr>
<td>39-0000</td>
<td>Personal care and service</td>
<td>48.67</td>
<td>6.95</td>
<td>2.68</td>
</tr>
<tr>
<td>41-0000</td>
<td>Sales and related occupations</td>
<td>35.16</td>
<td>7.59</td>
<td>3.08</td>
</tr>
<tr>
<td>43-0000</td>
<td>Office and administrative support</td>
<td>48.52</td>
<td>9.18</td>
<td>3.4</td>
</tr>
<tr>
<td>45-0000</td>
<td>Farming, fishing, and forestry</td>
<td>38.53</td>
<td>6.75</td>
<td>2.51</td>
</tr>
<tr>
<td>47-0000</td>
<td>Construction and extraction</td>
<td>66.63</td>
<td>10.6</td>
<td>2.5</td>
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<td>49-0000</td>
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<td>42.93</td>
<td>11.05</td>
<td>3.29</td>
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<tr>
<td>51-0000</td>
<td>Production</td>
<td>44.42</td>
<td>8.94</td>
<td>3.88</td>
</tr>
<tr>
<td>53-0000</td>
<td>Transportation and material moving</td>
<td>41.12</td>
<td>8.33</td>
<td>3.15</td>
</tr>
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</table>
How realistic are our numbers?

<table>
<thead>
<tr>
<th></th>
<th>Projected</th>
<th>HWOL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total annual openings</strong></td>
<td>1,254,218</td>
<td>872,286</td>
</tr>
<tr>
<td>Software developers</td>
<td>22,679</td>
<td>26,964</td>
</tr>
<tr>
<td>Computer system analysts</td>
<td>7,183</td>
<td>8,654</td>
</tr>
<tr>
<td>Total computer and mathematical occupations</td>
<td>60,107</td>
<td>95,903</td>
</tr>
</tbody>
</table>

JOLT survey: combined percentage of hiring’s in *West region* in 2016 was 43.9 percent for total nonfarm employment. Our number was 32.3 percent.
Top 20 specific occupations by average annual total openings, alternative methodology
Washington state, 2015-2025

Occupations

- Retail salespersons
- Combined food prep. and serving workers, incl. fast food
- Farmworkers and laborers, crop, nursery and greenhouse
- Office clerks, general
- Laborers and freight, stock and material movers, hand
- Carpenters
- Software developers, applications
- Cashiers
- Waiters and waitresses
- Janitors and cleaners, exc. maids and housekeeping cleaners
- Personal care aides
- Customer service representatives
- Construction laborers
- Registered nurses
- General and operations managers
- Bookkeeping, accounting and auditing clerks
- Landscaping and groundskeeping workers
- Cooks, restaurant
- Secretaries and admin. assist., exc.legal, medical and exec.
- Heavy and tractor-trailer truck drivers

Average annual openings due to growth
Average annual openings due to alternative rate
Top 20 specific occupations by average annual total openings, separations methodology
Washington State, 2015 to 2025

- Combined food prep. and serving workers, incl. fast food
- Retail salespersons
- Cashiers
- Farmworkers and laborers, crop, nursery and greenhouse
- Waiters and waitresses
- Office clerks, general
- Laborers and freight, stock and material movers, hand
- Customer service representatives
- Software developers, applications
- Janitors and cleaners, exc. maids and housekeeping cleaners
- Personal care aides
- Teacher assistants
- Carpenters
- Secretaries and admin. assist., exc. legal, medical and exe.
- Bookkeeping, accounting and auditing clerks
- Construction laborers
- Cooks, restaurant
- Landscaping and groundskeeping workers
- Sales reps., wholesale and manuf., exc. tech. and scientific...
- Registered nurses
Pros and Cons
Prior BLS net replacement rates

- Pros – not used anymore.
- Cons – numbers are unrealistic, not intended to represent all job openings, do not reflect state specifics.
Pros and Cons
New national separation rates

- Pros – numbers are realistic and directly based on occupational data; they allow to estimate transitions between occupations.
- Cons – numbers do not reflect total job openings or states’ unique structures.
Pros

Alternative state specific rates

- Pros – numbers are realistic, based on solid administrative data, reflect a state's unique structures and represents estimations of total job openings.
Cons

Alternative state specific rates

- Cons – estimations are not directly targeted at occupations, but instead at jobs within occupations. Estimations rely heavily on staffing patterns. They are tied to industries and assume equal rates for all occupations in an industry. Openings cannot be separated into transitions within the same occupation and between occupations.
Possible improvements

- Use wage files with extended time periods.
- More combinations of paired quarters for more stable estimations of annual data. For example, 2014Q4-2015Q4, 2015Q1-2016Q1.
- Use survey data or HWOL.
- Attempt to estimate the variance in turnover rates by occupations within specific industries.
Possible applications

- Could be used for other states.
- A simplified version could be developed based on results from LED data for states.
Contact Information

Employment Security Department
WASHINGON STATE
Workforce Information and Technology Service

Alex Roubinchtsein
Projections & Statistical Analysis Manager

tel (360) 407-4581
fax (360) 407-4560
ARoubinchtsein@ESD.wa.gov

640 Woodland Square Loop SE Lacey, WA
PO Box 9046
Olympia, WA 98507

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www.esd.wa.gov