
2. Problem B.9

3. Problem B.10

4. Wages ($W$) and years of education ($X$) have the following joint distribution:

<table>
<thead>
<tr>
<th></th>
<th>$X = 10$</th>
<th>$X = 12$</th>
<th>$X = 14$</th>
<th>$X = 16$</th>
<th>$X = 18$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$W = 5$</td>
<td>$\frac{10}{100}$</td>
<td>$\frac{5}{100}$</td>
<td>$\frac{3}{100}$</td>
<td>$\frac{2}{100}$</td>
<td>$\frac{1}{100}$</td>
</tr>
<tr>
<td>$W = 10$</td>
<td>$\frac{6}{100}$</td>
<td>$\frac{1}{100}$</td>
<td>$\frac{2}{100}$</td>
<td>$\frac{4}{100}$</td>
<td>$\frac{3}{100}$</td>
</tr>
<tr>
<td>$W = 15$</td>
<td>$\frac{3}{100}$</td>
<td>$\frac{3}{100}$</td>
<td>$\frac{2}{100}$</td>
<td>$\frac{5}{100}$</td>
<td>$\frac{6}{100}$</td>
</tr>
<tr>
<td>$W = 20$</td>
<td>$\frac{1}{100}$</td>
<td>$\frac{5}{100}$</td>
<td>$\frac{3}{100}$</td>
<td>$\frac{3}{100}$</td>
<td>$\frac{2}{100}$</td>
</tr>
</tbody>
</table>

The fractions in the table are the probabilities. For example,

$$P(W = 5 \text{ and } X = 10) = \frac{10}{100}.$$  

(a) Find the marginal probability distribution for wages $W$.

Hint: $W$ takes the values 5, 10, 15, and 20. You need to find the probability that $W$ equals each of these four values.

(b) Find the marginal probability distribution for education $X$.

(c) Find the conditional expectation function $E(W \mid X = x)$.

Hint: The function $E(W \mid X = x)$ will be a single number at each of $x = 10, 12, 14, 16,$ and $18$.

(d) Plot $E(W \mid X = x)$ against $X$. Is the function increasing or decreasing in education?

(e) Find $E(E(W \mid X))$, the expected value of $E(W \mid X)$.

Hint: $E(W \mid X)$ takes the five values found in part (c), with the probabilities given by the distribution for $X$ found in part (b).

(f) Find $E(W)$ from the marginal probability distribution from part (a), and verify the law of iterated expectations:

$$E(W) = E(E(W \mid X)).$$