Answer 1: The regression is:

\[ \text{LWAGE} = \beta_0 + \beta_s \times S + \beta_h \times \text{HOURS} + \beta_m \times \text{MALE} + \beta_e \times \text{EXP} + \beta_{me} \times \text{MEXP} + \epsilon. \]

Note that \( \text{MEXP} \) is determined by \( M \) and \( \text{EXP} \).

(a) The coefficients of the regressors in this regression can be interpreted as follows:

\[(i) \quad \beta_0 = E[\text{LWAGE}|S = 0, \text{HOURS} = 0, \text{MALE} = 0, \text{EXP} = 0],\]

i.e., the expected log earnings of a female who has 0 years of schooling, 0 years of experience and who works for zero hours. From our data, we estimate this as .196, i.e. 1.22 USD per hour. Of course, as discussed in the class, the intercept term in itself does not have much meaning – it helps to adjust the level of the prediction of the dependent variable.

\[(ii) \quad \beta_s = E[\text{LWAGE}|S = s + 1, \text{HOURS} = h, \text{MALE} = m, \text{EXP} = e, \text{MEXP} = m \times e] - E[\text{LWAGE}|S = s, \text{HOURS} = h, \text{MALE} = m, \text{EXP} = e, \text{MEXP} = m \times e],\]

i.e., the marginal effect of one additional grade completed in school (for individuals who are otherwise same in terms of gender, hours worked and experience). The estimate of this marginal effect from our data suggests that each additional grade completed in school will increase the hourly earnings of the individual by 12.1 percent.

\[(iii) \quad \beta_h = E[\text{LWAGE}|S = s, \text{HOURS} = h + 1, \text{MALE} = m, \text{EXP} = e, \text{MEXP} = m \times e] - E[\text{LWAGE}|S = s, \text{HOURS} = h, \text{MALE} = m, \text{EXP} = e, \text{MEXP} = m \times e],\]

i.e., the marginal effect of working one additional hour (for individuals who are otherwise same in terms of gender, schooling and experience). The estimate of this marginal effect from our data suggests that each additional hours worked will increase the hourly earnings of the individual by .5 percent. [Can you explain this small effect? Note that the increase is in terms of hourly earnings and not total earnings.]

\[(iv) \quad \beta_m = E[\text{LWAGE}|S = s, \text{HOURS} = h, \text{MALE} = 1, \text{EXP} = 0, \text{MEXP} = 1 \times 0] - E[\text{LWAGE}|S = s, \text{HOURS} = h, \text{MALE} = 0, \text{EXP} = 0, \text{MEXP} = 0 \times 0],\]

i.e., the marginal effect of being a male for individuals who have same schooling, work the same number of hours but have 0 experience. So this is the premium in wage that a male will receive with respect to a female (with same schooling) when they start working in job that involves the same number of hours of work. The estimate of this marginal effect from our data suggests that being a male comes with a wage premium of 31.6 percent when you
start working (with 0 experience).

\[(v) \quad \beta_e = E[LWAGE|S = s, HOURS = h, MALE = 0, EXP = e + 1, MEXP = 0 \times (e + 1)] - E[LWAGE|S = s, HOURS = h, MALE = 0, EXP = e, MEXP = 0 \times e],\]

i.e., the marginal effect on earnings of one additional year of experience for a female. The estimate of this marginal effect from our data suggests that with the same level of schooling and hours worked, a female will earn 3.3 percent more with each additional years of experience.

\[(vi) \quad \beta_{me} = \{E[LWAGE|S = s, HOURS = h, MALE = 1, EXP = e + 1, MEXP = 1 \times (e + 1)] - E[LWAGE|S = s, HOURS = h, MALE = 1, EXP = e, MEXP = 1 \times e]\}

\[\{E[LWAGE|S = s, HOURS = h, MALE = 0, EXP = e + 1, MEXP = 0 \times (e + 1)] - E[LWAGE|S = s, HOURS = h, MALE = 0, EXP = e, MEXP = 0 \times e]\}\]

i.e., the difference in the marginal effects on earnings of one additional year of experience for a male and a female who have same level of schooling and work same number of hours. The estimate of this difference in marginal effects from our data suggests that with the same level of schooling and hours worked, a female gains about .4 percent more from one additional year of experience than a male. [In some ways, this can be interpreted as a way in which the market corrects for the initial wage premium that a male receives. But the correction is a slow process, on average.]

(b) From the above interpretations of the coefficients, we can directly conclude that the marginal effect of being a male on the earnings of an individual with 5 years of experience is

\[\beta_m + 5 \times \beta_{me} = E[LWAGE|S = s, HOURS = h, MALE = 1, EXP = 5, MEXP = 1 \times 5] - E[LWAGE|S = s, HOURS = h, MALE = 0, EXP = 5, MEXP = 0 \times 5].\]

Therefore, the estimate and the standard error are:

\[\text{estimate} = \hat{\beta}_m + 5 \times \hat{\beta}_{me} = 29.6 \text{ percent}\]
\[\text{se} = \sqrt{Var(\hat{\beta}_m) + 5^2 \times Var(\hat{\beta}_{me}) + 2 \times 5 \times Cov(\hat{\beta}_m, \hat{\beta}_{me})} = 2.96 \text{ percent}.\]
**Answer 2:** The regression is:

\[
\text{LWAGE} = \beta_0 + \beta_s \times S + \beta_h \times \text{HOURS} + \beta_m \times \text{MALE} + \beta_b \times \text{ETHBLACK} + \beta_e \times \text{EXP} + \beta_{mbe} \times \text{MLBLKEXP} + \epsilon.
\]

Note that MLBLKEXP is determined by M, BLACK and EXP.

(a) To answer this question, let us follow what we did in class, i.e., consider the 4 different groups (by gender and ethnicity) and note that the expected LWAGE for these groups (where the individuals have \(S = s\), \(\text{HOURS} = h\), \(\text{EXP} = 10\) are:

- **WHITE, FEMALE** = \(\beta_0 + \beta_s \times s + \beta_h \times h + \beta_e \times 10\),
- **WHITE, MALE** = \(\beta_0 + \beta_s \times s + \beta_h \times h + \beta_e \times 10 + \beta_m\),
- **BLACK, FEMALE** = \(\beta_0 + \beta_s \times s + \beta_h \times h + \beta_e \times 10 + \beta_b\),
- **BLACK, MALE** = \(\beta_0 + \beta_s \times s + \beta_h \times h + \beta_e \times 10 + \beta_m + \beta_b + \beta_{mbe} \times 10\).

So the estimated effects for each group with respect to the omitted group White Female (taken as 0):

<table>
<thead>
<tr>
<th></th>
<th>ETHWHITE</th>
<th>ETHBLACK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FEMALE</strong></td>
<td>0</td>
<td>(\beta_b = -2.87)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(se = 2.04)</td>
</tr>
<tr>
<td><strong>MALE</strong></td>
<td>(\beta_m = 27.32)</td>
<td>(\beta_m + \beta_b + 10 \times \beta_{mbe} = (27.32 - 2.87 - 10 \times 1.59) = 8.59)</td>
</tr>
<tr>
<td></td>
<td>(se = 1.06)</td>
<td>(se = 1.85)</td>
</tr>
</tbody>
</table>

Table 1: Percentage Change in EARNINGS for belonging to each group.

(b) Note that the difference between females and males among whites is simply \(\beta_m\) (a constant), which is estimated from the data as a large positive number. On the other hand, the difference between males and females among blacks is \(\beta_m + \beta_{mbe} \times e\), this is not a constant and changes with the level of experience. The large positive value of \(\beta_m\) means the latter difference is positive, but with more experience black females tend to catch up the black males (who are otherwise similar to them) in terms earnings.

As before, note that the coefficient of the interaction term has an interpretation as the difference in difference. More precisely, it is difference in the marginal effect of one additional year of experience between (difference in black males and females) and (difference in white males and females).