We would certainly worry about an omitted variables problem here. Things like parental education, support, income, etc. probably enter the error term (i.e., they are likely to have independent effects on GPA), and at the same time, these omitted factors are also likely to correlate with PC ownership. (That is, such parents are also probably more likely to purchase a PC for their children). So, we would worry about a mean-independence violation.

This is summarized above - students from wealthy families are more likely to purchase a PC for their children.

This means that parental income would satisfy one, but not two, of the conditions required for a valid IV. It would be correlated with the endogenous variable, but, given our answer in (1i), it would likely be correlated with the error $u$.

Construct a dummy variable called $grant$, where $grant_i$ is one if student $i$ received a grant, and is otherwise equal to zero. We would need $grant$ to be correlated with $PC$ (which, presumably, it is since those receiving such a grant would purchase a PC), but uncorrelated with $u$. If the grant assignment is truly random, then we should not worry about correlation with the error term.

There are many other possible identification strategies. One might be the assignment of students to residence halls. If this is random, and some (larger) halls have computer labs while others do not, then students in dorms with labs would be less likely to buy a PC than those in dorms without such labs. Again, the random assignment assumption remains critical to the validity of this strategy.

This would seem to be particularly important in schools like ISU where the weather would have a big effect on attendance. On a cold day, for example, students in dorms far away from Heady would be less likely to attend than students close to Heady.

Is $dist$ correlated with $u$? This is hard to say. If students living off campus, for example, are “different” in ways that are important as independent predictors of $stnd fnl$, then we would worry about $dist$’s validity as an instrument. If the nearby residence hall, for example, were an “honors” hall (i.e., it has high achieving students), then we would also worry about its validity. Of course, some of these concerns are mitigated by having $priGPA$ and $ACT$ in the regression itself, so it is more likely to be a reasonable instrument. But, you can always tell stories ...

$dist$ must be conditionally or partially correlated with $attndrte$. That is, if we fit the
regression model

\[ \text{atndrte} = \beta_0 + \beta_1 \text{dist} + \beta_2 \text{priGPA} + \beta_3 \text{ACT} + u, \]

then \( \beta_1 \) must be different from zero.

(iii) Based on the hint, we could use \( \text{priGPA} \times \text{dist} \) as an instrument. It is uncorrelated with the error (by assumption) and should also be partially correlated with \( \text{priGPA} \times \text{atndrte} \).

(3i) The regression output is provided as a separate attachment. The coefficient on sibs is -.027, which is clearly different from the estimated return to education.

(ii) We would expect \( \text{brthord} \) to be negatively correlated with education since first-born (or early-born) children are likely to receive more attention from their parents, and \( \text{brthord} \) may also be correlated with family size, which again would proxy the amount of time that a parent would be able to devote to a particular child. In addition, those children coming first would be the first children going to college, and thus the family may be in a better financial position to send first-born children to school rather than subsequent children. The regression results suggest that \( \text{brthord} \) is significant in the education regression, and that increasing \( \text{brthord} \) by 1 reduces educational attainment (on average) by .28 years.

(iii) The IV point estimates are also provided on the attachment. This result is close to what we get when we used SIBS as the IV. Specifically, the IV point estimate is about .13, suggesting that an added year of education increases your expected wage by about 13 percent.

(The attached STATA output also verifies the results of Example 15.2).

(iv) The identification condition is \( \pi_2 = 0 \). We hope to reject this hypothesis. The attached STATA output shows that \( \text{brthord} \) is significant at the 5 and 1 percent levels, even conditioned on \( \text{sibs} \). This suggests some role in the order of birth itself above and beyond any direct effect of overall family size.

(4i and ii) The attached STATA output notes the equivalence of the point estimates from both approaches.