9.1 For concept review, see class notes and text.

The general idea is simple. A country with a relatively large share of the population old (or very young) will have a relatively higher death rate than a country with the large share of the population in age categories where death rates are lower. We show this can be true even when age specific death rates are somewhat lower in the country with the higher overall death rate.

Consider the following hypothetical table, which shows death rates per thousand in different age groups, as well as the percentage of the population in each of the age groups, for two different countries A and B.

<table>
<thead>
<tr>
<th>SHARE OF POPULATION IN AGE GROUP</th>
<th>DEATH RATES IN AGE GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country</td>
<td>0-14</td>
</tr>
<tr>
<td>A</td>
<td>44</td>
</tr>
<tr>
<td>B</td>
<td>19</td>
</tr>
</tbody>
</table>

In this hypothetical example, country A has higher death rates in every category compared to country B.

Let’s calculate the overall death rates, which are given by a weighted average of the age-specific death rates, using population shares as weights.

For country A overall death rates are: 
\[ \frac{44}{100} + \frac{53}{100} + \frac{3}{100} + \frac{10}{100} + \frac{5}{100} + \frac{50}{100} = 8.55 \]

For country B overall death rates are: 
\[ \frac{19}{100} + \frac{67}{100} + \frac{14}{100} + \frac{7}{100} + \frac{4}{100} + \frac{40}{100} = 9.61 \]

Although country A has individual age category death rates that are higher, overall death rates are higher in country B.

9.5.a In this question the probability that a child will look after his or her parents in old age is given at 1/2. The tolerance probability, the probability that at least one child will look after the parents, is denoted by \( q \). As discussed in class, the couple will try to have \( n \) kids, where \( n \) is the smallest number such that

\[ 1 - (1 - p)^n \geq q \]
\[ \rightarrow 1 - \left(\frac{1}{2}\right)^n \geq q \]
\[ \rightarrow 1 - q \geq \left(\frac{1}{2}\right)^n \]

This expression makes clear the point that the more risk averse the couple is to risk the closer the closer the value of \( q \) will be to one and the larger will have to be the value of \( n \). You can calculate different values for \( n \) using your calculator (as \( q \) varies). Suppose \( q \) is 90% then \( n \) will be at least four; if \( q \) is 95% then \( n \) will be at least five.
9.10 (i) Payments in Oz would be to three factors of production: capital, mental labor, and physical labor. Because men are assumed to have greater endowments of physical labor, they would be paid more once we add up these sources of income (this answer assumes that all capital is held jointly by families, and that we are talking about the incomes of married individuals (why?)).

(ii) If physical capital increases, the marginal products of both physical and mental labor rise, but because mental labor is more complementary to technology, one would expect the return to this input to rise relative to the return to physical labor. As a consequence, one would expect the relative wages of women to rise.

(iii) This question simply asks you to tag on the current situation to another that we have discussed in class and in the text: that a higher relative wage of women tends to reduce fertility. Review these arguments and show that richer countries in general will tend to have lower rates of fertility.

9.12
(a) True. See question 1.

(b) True. See tables in text.

(c) False. It depends on the age distribution of the population. Recall that the fertility rate is simply the number of births divided by the number of women in child bearing years (in the US ages 15-44). It is possible for the fertility rate in one country to be lower than in another country, and yet for the population growth rate in the former country to be higher. Why? It is simple to show in a manner analogous to question 1. The country with a relatively lower fertility rate may have more births because there is a greater share of the female population between ages 15-44 – child bearing years.

(d) True. This has to do with macro-interia and micro-inertia, discussed in the text and in class. Make sure you understand that material.

(e) True. Use the idea of a shift from hoarding to targeting, as the incidence of mortality shifts from late to early childhood. Why would such a shift be possible as infant mortality falls?

10.3
**Agricultural surplus**: This is the food surplus left over from agriculture, after feeding all those who live and work there, and can be applied to sustaining a nonagricultural labor force.

**Average agricultural surplus**: This is simply the overall agricultural surplus, divided by the number of people who are outside the agricultural sector. So this provides a measure of per-capita availability.

**Surplus labor**: That part of the labor force which can be removed from some economic activity without leading to any drop in the level of that activity. Typically associated with agriculture, and with the notion of zero marginal product.

**Disguised unemployment**: That part of the labor force for whom the marginal product of labor is less than the going wage rate in the economy. Recall from class why this is an important concept.
**Family farming**: A method of production in which family members participate in cultivation, dividing the output equally or in some given proportion. Disguised unemployment is typically associated with such modes of production (why?).

**Capitalist farming**: A method of production in which hired labor is used and output is produced so as to maximize profits. Unlike family farming, the employment of labor is typically regarded as a cost and not an end in itself.

10.4 The idea of this question is to understand that when labor is removed from a family farm with surplus labor, the average income of those left behind tends to *increase*. By drawing a diagram, verify that this will always happen as long as the average product of labor exceeds its marginal product.

This phenomenon is not unique to surplus labor but is more pronounced here simply because total output holds steady when labor is removed. But if this occurs, the supply curve of labor to the industrial sector should not stay flat even in the surplus labor phase. This is because as more and more labor is moved away from the family farm, the remainder enjoy a higher per-capita income.

So this part of the Lewis model must assume that the surplus generated is somehow taxed away by the government for sale in the urban area. This is not to say that the food surplus is *always* taxed, but only to argue that there is a connection between the degree of taxation and the flatness of the supply curve.

10.8
(i) Let the threshold fraction of formal jobs to total labor force be denoted by $p$. Then, using the Harris-Todaro model, Pim will get a wage of 1200 with probability $p$, and a wage of 400 with the remaining probability $1 - p$.

Thus the expected income from migration is $1200p + 400(1 - p)$, and if this is less than 1000 (which is what she gets on the farm - $4000 divided by four sisters – average product), she will not migrate. Thus we need

$$1200p + 400(1 - p) \leq 1000$$

Solving for $p$ we see that $p$ must be less than $\frac{1}{4}$ in order for Pim to remain on the farm.

(ii) If family income rather than individual income is at stake, Pim reasons as follows. If the threshold proportion that you calculated in the previous answer prevails, then the expected income from Pim’s migration is 1000, which accrues to the family. On the other hand, by looking at the production function you can see that agricultural income falls by 700. The family gain exceeds the family loss, so Pim goes off. That is, Pim can compensate the family with the 700 loss and still be 300 dollars ahead – which she can also give the family.

(iii) Yes, another sister will *also* migrate, for the expected gain is 1000, while agricultural output falls by another 800 (move from three sisters to two in the table). This is worth it to the family. The third sister is exactly indifferent (check this), so if there is a small cost to migrating, she will not. Thus, family-based decisions lead to two people migrating from Pim’s farm, whereas with individualistic migration, there were none.

(iv.) To understand why, observe that because of diminishing returns and income-sharing in the family farm, the average product exceeds the marginal product. A selfish migrant will look at her loss of the *average* product, which is 1000. But a family-based migrant will realize that the loss to
the family from migration is less (the marginal product), so she will migrate to maximize family income.

But note that to maximize family farm income this assumes that Pim, for instance, will compensate the family the farm income it has lost with her wages earned in the urban sector. However, a problem may arise here because of remittances may not be a costless process (it may be difficult to send cash to the farm etc.) and it may be more costly to live in the city (due to an absence of the important informal mechanisms at play in the rural sector that we discussed earlier).