ECO220Y1Y, Test #4, Prof. Murdock SOLUTIONS

(1) (a) From the aid sheets $b_j \pm t_{\alpha/2} s_{b_j}$ with degrees of freedom $\nu = n - k - 1 = 47 - 2 - 1 = 44$.

$-0.3353905 \pm 2.015 * 0.0159661$

-0.3354 ± 0.0322

$LCL = -0.368$

$UCL = -0.303$

Using the weekly data from Levitt et al. (2013) for an undisclosed automobile manufacturer, after controlling for a time trend, as cumulative production experience rises by 10%, we are 95% confident that the average defects per car are between approximately 3.03% and 3.68% lower, on average. This is consistent with learning by doing.

(b) Because it is the y-variable, we find the square root of the SST divided by the sample size minus one.

$$s_y = \sqrt{\frac{\sum_{i=1}^{n}(y_i - \bar{Y})^2}{n-1}} = \sqrt{\frac{SST}{n-1}} = \sqrt{\frac{13.0454694}{47-1}} = 0.5325$$

(2) (a) $H_0: \rho = 0$ versus $H_1: \rho \neq 0$

$$F = \frac{R^2/k}{(1-R^2)/(n-k-1)} = \frac{(-0.428)^2/1}{(1-(-0.428)^2)/(19-1-1)} = \frac{0.1832}{0.8168/17} = \frac{0.1832}{0.0480} = 3.8$$

Using the F table and noting the denominator degrees of freedom is between 15 and 20, an F test statistic of 3.8 implies that the P-value is between 0.05 and 0.10, which means that this correlation is statistically significant at the 10% level but not the 5% level.

(b) Given that the correlation between IS and CR is stronger (-0.168) than for MS and SS (0.159), the P-value would be even smaller: we'd have stronger evidence against the null that the correlation is zero.

(3)(a) Management score would likely be "somewhat negatively skewed" because it ranges between 0 and 1 and the Empirical Rule would *nearly* hold even for plus/minus three standard deviations (i.e. 99.7% of firms have a management score between -0.002 and 1.174, which is not too far off the logical bounds of 0 and 1), but the mean is a bit smaller than the median, which often happens with negative skew. The number of employees is "extremely positively skewed" as that variable must be positive (no firm could have negative employees) and the standard deviation is far bigger than the mean.

(b) $1 - 0.112 - 0.425 = 0.463$ Hence, 46.3% are not family owned.

(c) The variable recording whether a firm is foreign owned is a dummy variable, which means it takes only two values (0 and 1). Once we know that 13.2% of firms are foreign owned (and, hence, 86.8% are not), there is nothing else to say about the variable.

$$SD[Foreign\ owned] = \sqrt{(1-0.132)(0-0.132)^2 + 0.132(1-0.132)^2} = \sqrt{0.132(1-0.132)} = 0.338$$

Alternatively, although more work, you could do:

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i-\bar{X})^2}{n-1}} = \sqrt{\frac{6{,}732*(0-0.132)^2+1{,}024*(1-0.132)^2}{7{,}756-1}} = \sqrt{\frac{888.8}{7{,}755}} = \sqrt{0.1146} \approx 0.338$$

(d) About 13% of the firms in the MES survey expected GDP growth from 1% to 3% in 2017-18 versus about 35% of professional forecasters. This is a huge difference of 22 percentage points. Professional forecasters are more optimistic about nontrivial positive GDP growth than the firms and are nearly three times as likely to predict 1 to 3 percent GDP growth.

(e) For the proportion expecting GDP growth in 2017-18 between 1% and 3%:

$$H_0: (p_{prof} - p_{firms}) = 0$$
$$H_1: (p_{prof} - p_{firms}) \neq 0$$

While we have the sample size of firms, which is 7,756 from Table 1, we do not know the number of professional forecasters the Bank of England surveyed: we are missing one of the relevant sample sizes for an inference about the difference in these proportions. However, given the huge difference and the huge sample size of firms, this difference is surely highly statistically significant.

(f) [First part of sentence already given], firms with a 10% larger number of employees on average have a management score, which is on a zero to one scale with higher values for better managed firms, that is approximately 0.0063 higher. Hence, larger firms are *very slightly* better managed: a difference of less than 0.01 given a mean management score of 0.59 with a standard deviation of 0.20 is a nearly flat slope.

(g) Firms that are family owned and run have management scores that are 0.015 lower on average compared to firms that are not family owned after controlling for log employment, foreign ownership, the age of the firm, the shares of managers and non-managers with a college degree, differences across industries, differences across locations in the UK, and variation in how the survey was completed.

(h) The intercept would decrease, the slope would increase, and the R^2 would decrease.

(i) The explanatory variable is the management score and it has a theoretical minimum of 0 and a theoretical maximum of 1: a one-unit change would not be a marginal change but, instead, a huge change that is outside the range of the sample (as no firms would have perfectly horrible or perfectly perfect management practices). They consider a really big change from the 10th to the 90th percentile of management practices and yet still only find a difference in the GDP growth forecast error of 0.18 percentage points, which is small and not economically significant.

(j) Approximately 6 percent of the variation in the absolute GDP forecast error across the 7,134 firms in this sample is explained by variation in their management practices, number of employees, age of the firm, share of managers and non-managers with a college degree, ownership status, type of industry, location in the UK, and other controls related to the survey completion. This is a tiny R-squared, which means it is very hard to predict firms' mistakes in forecasts of macro growth using these variables (despite there being a very large number of x variables).

(k) $H_0: \beta_{MS} = 0$ versus $H_1: \beta_{MS} \neq 0$. The degrees of freedom are huge given the huge n. Use Normal table to find the P-value for the test statistic: $t = \frac{-0.171}{0.0738} = -2.32$. $P - value = P(t < -2.32) + P(t > 2.32) = 2(0.5 - 0.4898) = 0.0204$. [This meets a 5% significance level, but not a 1% level, which means just two stars.]

(4) (a) Rossi (2022) offers an excellent answer: "While all employed workers tend to work fewer hours in rich countries compared to poor countries, this relationship is (mildly) weaker for high-skill workers."

(b) Only b_0 and b_3 would be negative. b_0 is the intercept of the dashed high-skill line and extrapolating back to an x value of zero, the intercept would clearly be negative given the steep slope. b_3 is the difference in slopes and clearly the low skill line has a lower slope compared to the high skill line, so it would be negative.