(a) $AIC = \log(s^2) + \frac{2k}{n}$

If smallest model is preferred

$$\log(s_0^2) + \frac{2p_0}{n} < \log(s_1^2) + \frac{2p_1}{n}$$

$$\log(s_0^2) - \log(s_1^2) < \frac{2}{n}(p_1 - p_0)$$

$$\log\left(\frac{s_0^2}{s_1^2}\right) < \frac{2}{n}(p_1 - p_0)$$

$$\frac{s_0^2}{s_1^2} < e^{\frac{2}{n}(p_1 - p_0)}$$

(b) For large values of n, $\frac{2}{n}(p_1 - p_0)$ becomes very small

So, $e^{\frac{2}{n}(p_1-p_0)} \approx 1 + \frac{2}{n}(p_1 - p_0)$

$$\frac{s_0^2}{s_1^2} < e^{\frac{2}{n}(p_1-p_0)} \approx 1 + \frac{2}{n}(p_1 - p_0)$$

$$\frac{s_0^2}{s_1^2} - 1 = \frac{s_0^2 - s_1^2}{s_1^2} < \frac{2}{n}(p_1 - p_0)$$

(c) As $e_R'e_R = s_0$, $e_u'e_u = s_1$

$$\frac{e_R'e_R - e_u'e_u}{e_u'e_u} = \frac{s_0^2 - s_1^2}{s_1^2} < \frac{2}{n}(p_1 - p_0)$$

(d) We know that $F = \frac{(e_R'e_R - e_u'e_u)/g}{e_u'e_u/n-k}$

Here $g = p_1 - p_0$, $k = p_1$. As n is very large compared to p_1

$$F = \frac{(e_R'e_R - e_u'e_u)/p_1-p_0}{e_u'e_u/n-p_1} \approx \frac{(e_R'e_R - e_u'e_u)/p_1-p_0}{e_u'e_u/n} < 2.$$

Proven.