8.)

a) For each year, the equation:

$$y = \beta_0 + \beta_1 X_1 + \ldots + \beta_{16} X_{16} + \varepsilon \qquad (K=17)$$

is estimated, separately. $e'e$, for each of 7 years, is reported in the table.

The unrestricted model, where the β's are allowed to be different for each year, consists of $7 \times 17 = 119$ parameters. The restricted model, where all β's have to be the same in each year, is obtained by "pooling" the data (ignoring year).

The null and alternative hypothesis's can be written as:

$$H_0: \beta_{0,1954} = \beta_{0,1955} = \ldots = \beta_{0,1960}$$

$$\beta_{1,1954} = \beta_{1,1954} = \ldots$$

$$\vdots$$

H_A: Not H_0.

The $e'e$ (unrestricted) is $104 + 88 + \ldots + 211 = 1260$

$$e_*'e_* = 1425$$

The F-stat is: $F = \dfrac{(e_*'e_* - e'e)/J}{e'e/(n-k)} = \dfrac{(1425-1260)/102}{1260/(540-119)} = 0.54$

But, we only have 5% critical values for the χ^2_J distribution.
However, we know that:

$$J \cdot F_{J,n-k} \xrightarrow{d} \chi^2_J$$

So, $102 \times 0.54 = 55.08$ is the value of the Wald stat. Since this value is below the crit. value of 126.57, we fail to reject H_0.

b) An equivalent way to perform the test is to include a dummy variable for each year, and jointly test to see if every coefficient on the dummies are equal to zero.

The model is:

$$y = \beta_0 + \beta_1 X_1 + \ldots + \beta_{16} X_{16}$$

$$+ \beta_{17} D_{1955} + \beta_{18} D_{1955} X_1 + \ldots + \beta_{33} D_{1955} X_{16}$$

$$\vdots$$

$$+ \qquad\qquad + \beta_{118} D_{1960} X_{16} + \varepsilon$$

$H_0: \beta_{17} = \ldots = \beta_{118} = 0 \qquad (J = 102)$
H_A: not H_0

The F-test statistic could be calculated by comparing the R^2 from the regression with $K = 119$ to the pooled model.