

## 04b Sample Examination Problems Chapter 10

---

1. (a) Derive from first principles the least squares estimator of slope for a simple linear regression.

- (b) The table below shows the population of England and Wales in millions for years in the 19th century.

Year	1801	1811	1821	1831	1841	1851	1861	1871
Popn.	8.89	10.16	12.00	13.90	15.91	17.93	20.07	22.71

- Find the least squares fit of a regression model for response variable population and explanatory variable year. Give the intercept and slope of the fitted line.
  - Should you fit a straight line through  $(0, 0)$  to these data rather than allowing an arbitrary intercept?
  - How would your fitted regression line change if the population were measured in thousands?
- 

2. (a) Find from first principles the least squares estimator for the slope of a line through the origin fitted to  $n$  pairs of values  $(x_i, Y_i)$ .

- (b) The table below shows Regional Manufacturing Capital Stock Estimates in millions of pounds sterling at 1970 prices in Wales and in Scotland.

- Find the least squares fit of a regression model for response variable Scotland Capital Stock and explanatory variable Wales Capital Stock.
- Interpret your regression line.

Year	1950	1951	1952	1953	1954	1955	1956	1957	1958
Wales	1116	1162	1219	1256	1316	1381	1426	1500	1563
Scotland	1746	1815	1868	1918	1958	2011	2066	2110	2153

---

3. (a) Derive from first principles the least squares estimators of intercept and slope for a simple linear regression model.
- (b) The following table shows the proportions of part-time women employees in Great Britain according to the New Earnings Survey (NES) and the Labour Force Survey (LFS), over several recent years.
- Make a scatter diagram for these data.
  - Fit a regression model with response variable the LFS percentages, and explanatory variable the NES percentages.
  - Is your fitted model sensible?

Year	NES %	LFS %
1985	32.6	44.6
1986	32.9	45.0
1987	32.6	45.0
1988	32.6	44.5
1989	31.9	43.7
1990	32.8	43.3
1991	33.0	43.4
1992	33.9	43.8
1993	34.7	43.7