

4.4 The general manager of a large engineering firm wants to know whether the experience of technical artists influences their work quality. A random sample of 50 artists is selected. Using years of work experience (*EXPER*) and a performance rating (*RATING*, on a 100-point scale), two models are estimated by least squares. The estimates and standard errors are as follows:

Model 1:

$$\widehat{RATING} = 64.289 + 0.990EXPER \quad N = 50 \quad R^2 = 0.3793$$

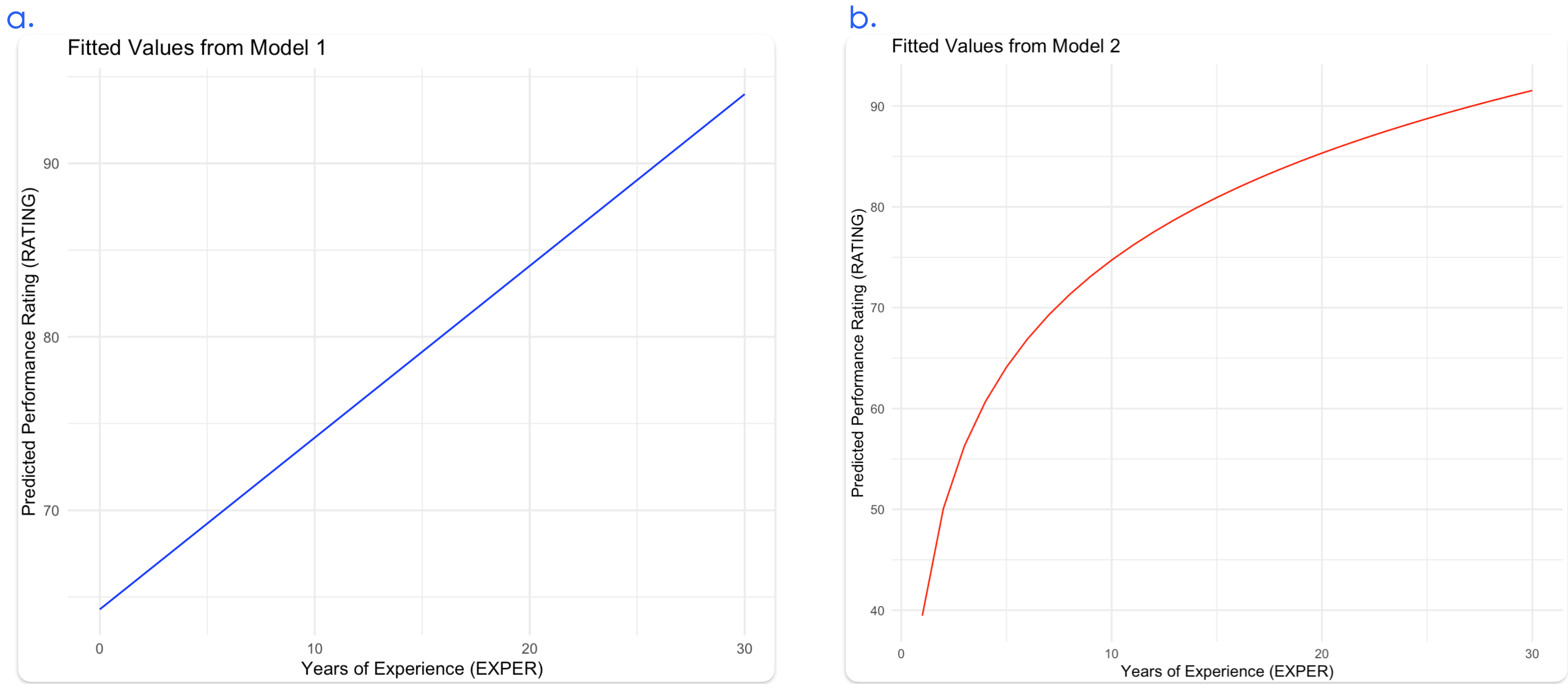
(se)            (2.422) (0.183)

Model 2:

$$\widehat{RATING} = 39.464 + 15.312 \ln(EXPER) \quad N = 46 \quad R^2 = 0.6414$$

(se)            (4.198) (1.727)

- a. Sketch the fitted values from Model 1 for *EXPER* = 0 to 30 years.
- b. Sketch the fitted values from Model 2 against *EXPER* = 1 to 30 years. Explain why the four artists with no experience are not used in the estimation of Model 2.
- c. Using Model 1, compute the marginal effect on *RATING* of another year of experience for (i) an artist with 10 years of experience and (ii) an artist with 20 years of experience.
- d. Using Model 2, compute the marginal effect on *RATING* of another year of experience for (i) an artist with 10 years of experience and (ii) an artist with 20 years of experience.
- e. Which of the two models fits the data better? Estimation of Model 1 using just the technical artists with some experience yields  $R^2 = 0.4858$ .
- f. Do you find Model 1 or Model 2 more reasonable, or plausible, based on economic reasoning? Explain.



- b. Model 1 的回歸公式為 線性模型，可以接受所有樣本，因此 N=50。Model 2 的回歸公式為 對數模型，其中  $\ln(EXPER)$  要求  $EXPER > 0$ ，因此  $EXPER=0$  的樣本無法使用，導致樣本數下降到 N=46。這意味著有 4 名藝術家 在數據集中其  $EXPER = 0$ ，導致 Model 2 無法將他們納入分析。使得樣本數從 Model 1 的 50 減少到 Model 2 的 46。
- c.  $\frac{\partial RATING}{\partial EXPER} = 0.990$
- (i) when  $EXPER = 10$ , marginal effect = 0.990  
(ii) when  $EXPER = 20$ , marginal effect = 0.990  
在 Model 1 中，不論是擁有 10 年或 20 年經驗的藝術家，每多 1 年經驗，*RATING* 都會增加 0.990 分。
- d.  $\frac{\partial RATING}{\partial EXPER} = \frac{15.312}{EXPER}$
- (i) when  $EXPER = 10$ , marginal effect =  $15.312 \div 10 = 1.5312$   
(ii) when  $EXPER = 20$ , marginal effect =  $15.312 \div 20 = 0.7656$   
在 Model 2 中，邊際效應隨著經驗增加而遞減：
- 當藝術家有 10 年經驗時，額外 1 年經驗可提升 1.5312 分 *RATING*。
  - 當藝術家有 20 年經驗時，額外 1 年經驗僅提升 0.7656 分 *RATING*。
- e. Model 2 的  $R^2=0.6414$ ，遠高於 Model 1 的 0.4858 和 0.3793，表示 Model 2 能更準確地解釋 *RATING*。
- f. Model 2（對數回歸）更符合經濟學原理，因為它考慮了邊際報酬遞減的現象，符合職場成長的現實情況，捕捉了「前期學習快，後期成長慢」的特性。Model 1（線性回歸）雖然簡單，但它假設經驗與績效的關係是恆定的，這在現實中不太可能成立，因此較不具說服力。