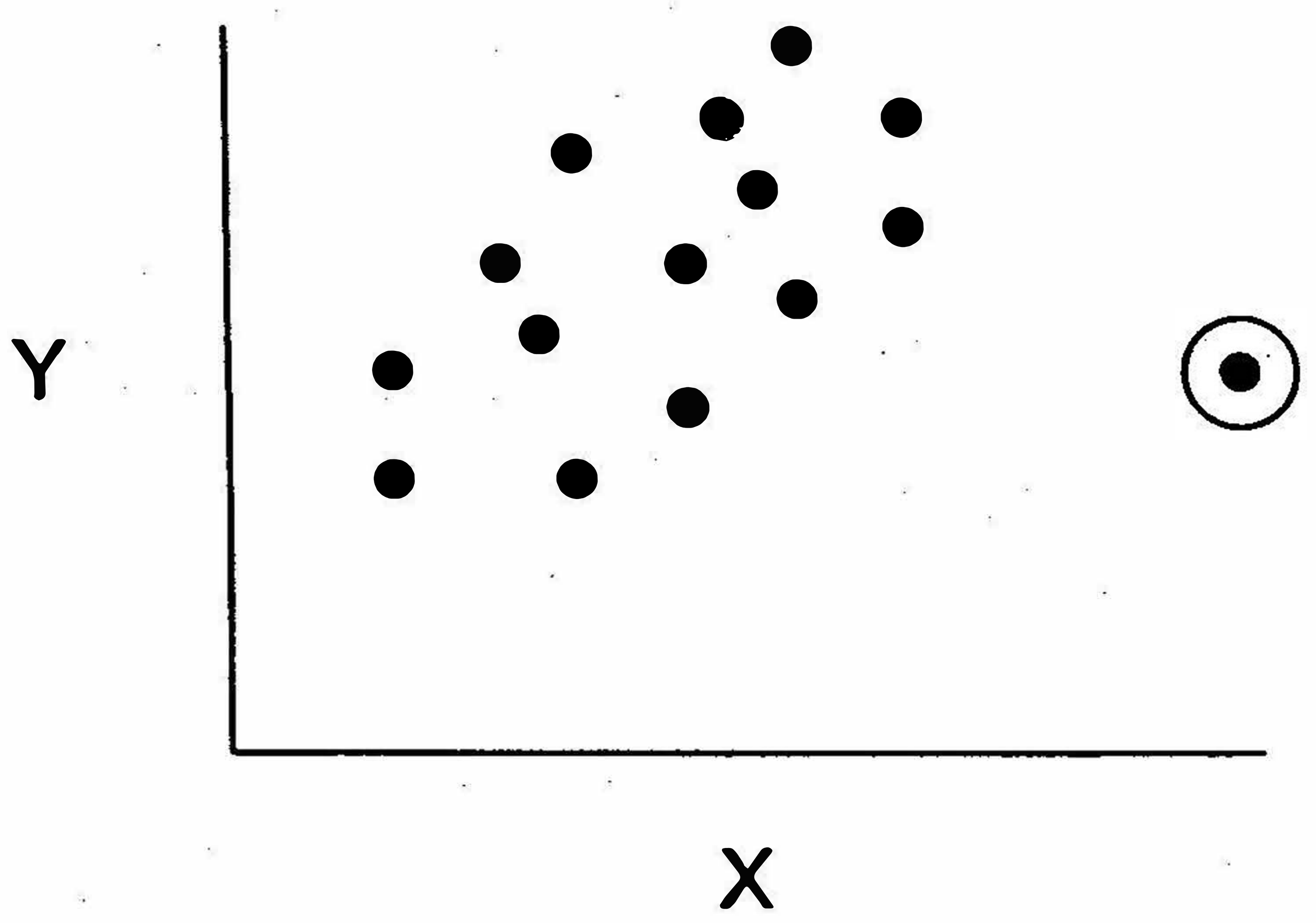
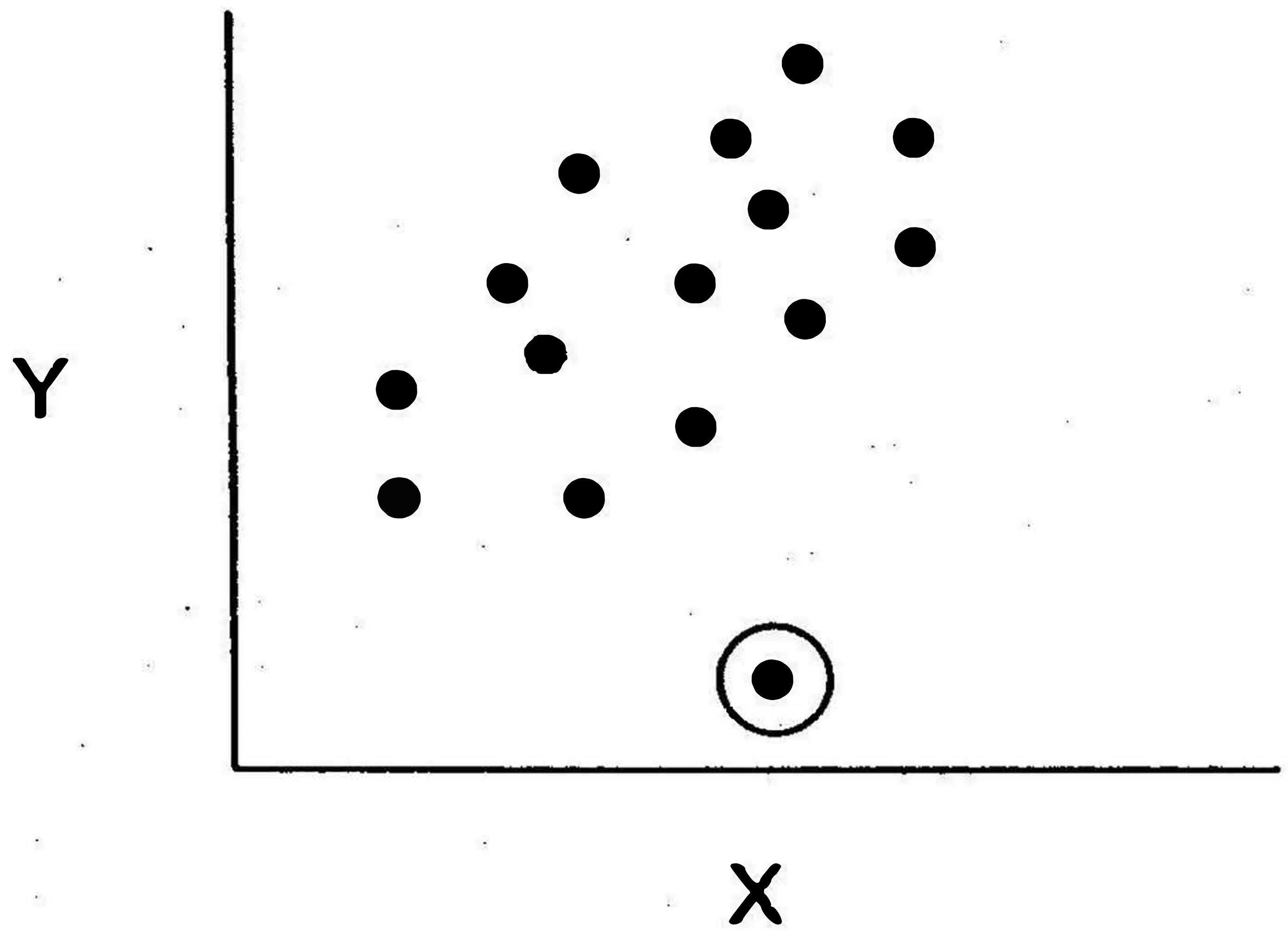
Outlier on X only

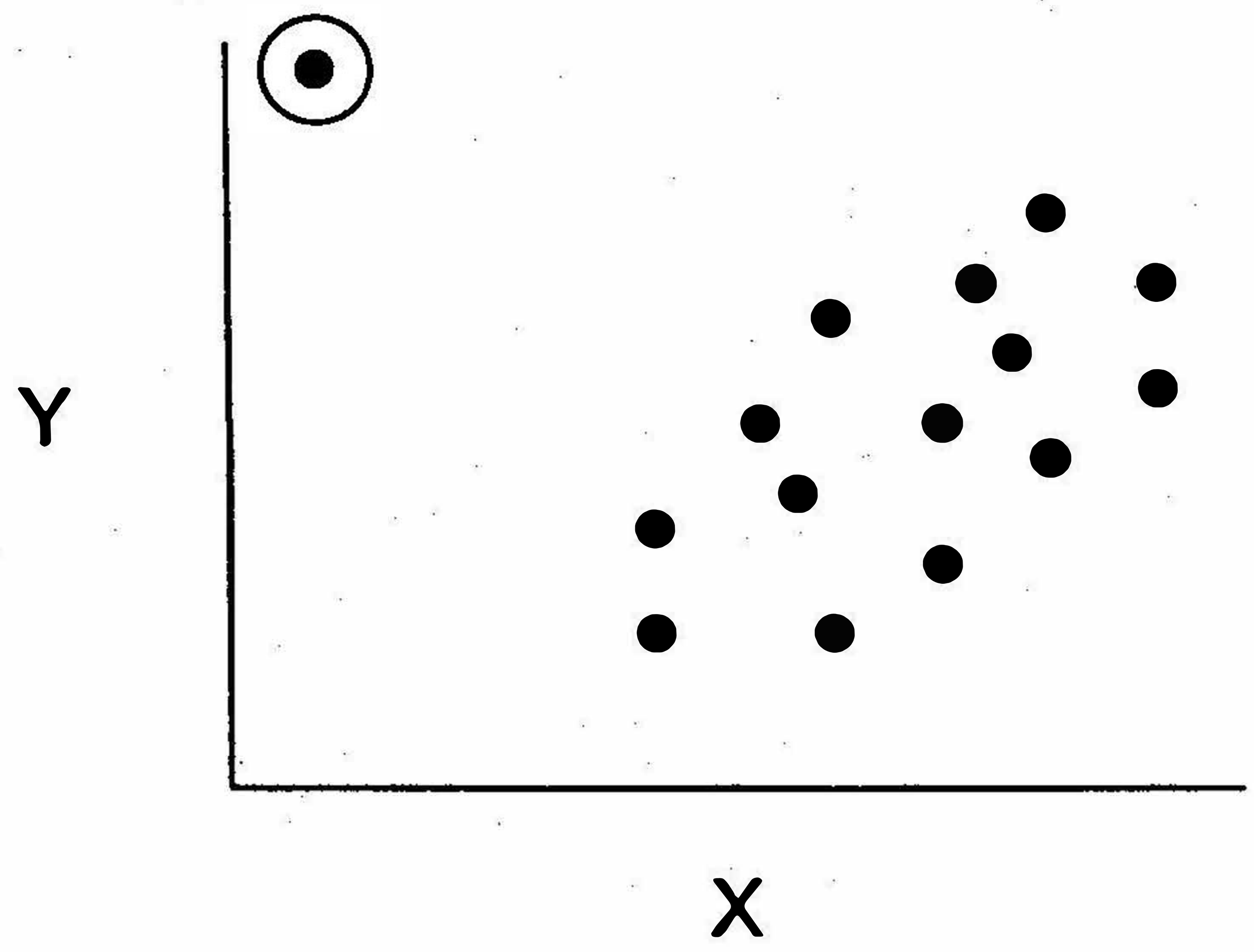


Outlier on Y only



Outlier on X & Y
Not influential

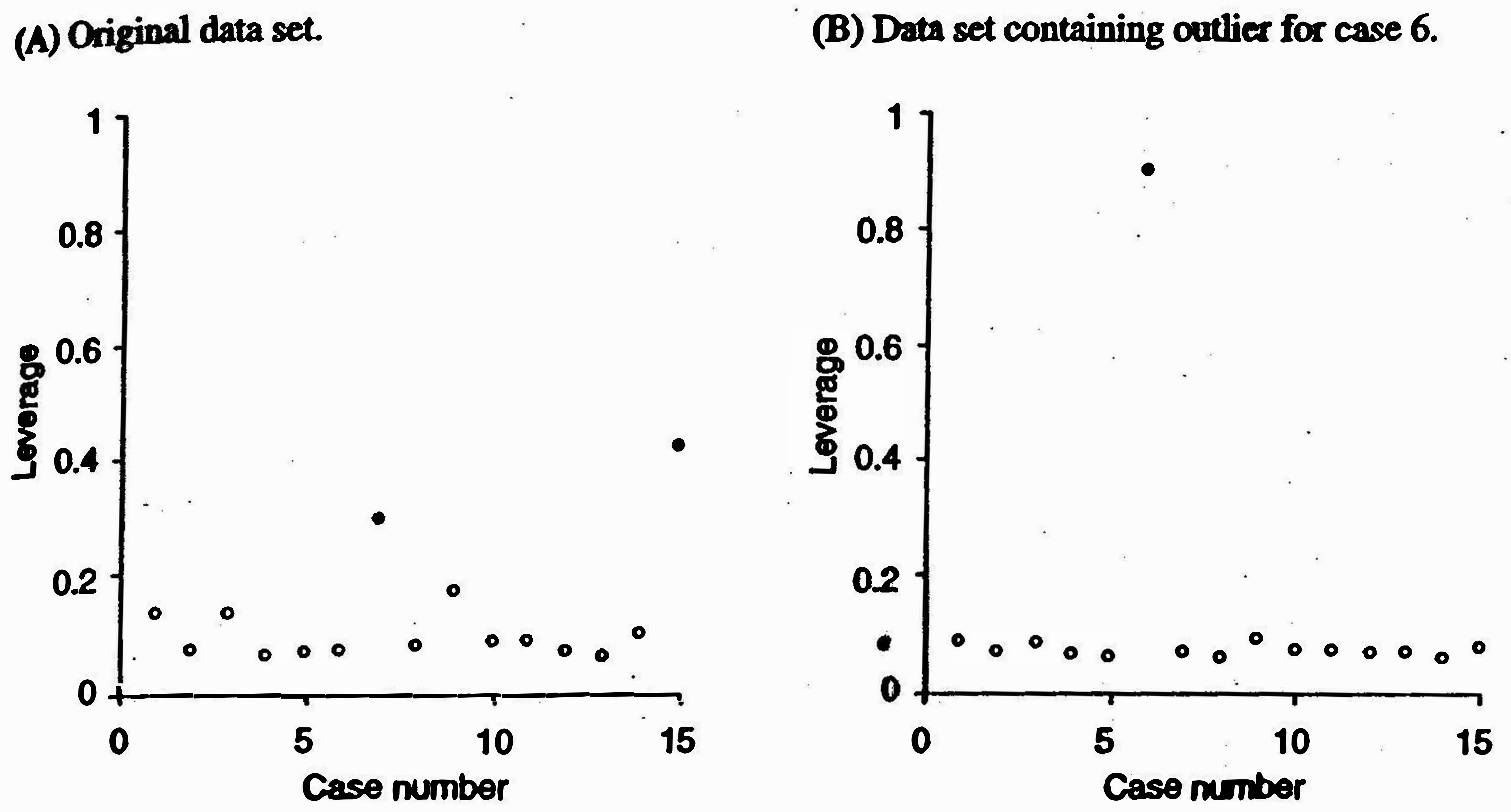
Outlier on X & Y
Influential



Figures reproduced from:

Cohen, J., Cohen, P., West, S.G., & Aiken, L.S. (2003). Applied multiple regression/correlation analysis in the behavioral sciences (Third Edition). Mahwah, NJ: Erlbaum.

Fox, J. (1997). Applied regression analysis, linear models, and related methods. Thousand Oaks, CA: Sage.



Note: The case number for each participant is shown on the abscissa (x axis). The value of leverage (h_{ii}) is shown on the ordinate (y axis). Cases with relatively high values of leverage are indicated by • in each panel. In Fig. 10.3.1(A), which contains the original data, cases 7 ($h_{ii} = .30$) and 15 ($h_{ii} = .43$) have somewhat higher leverage values than the other points since their years since Ph.D. are the most extreme in the data set (case 7, $X = 16$; case 15, $X = 18$). In Fig. 10.3.1(B), which contains the outlier, case 6 ($X = 60$; $h_{ii} = .90$) has an extremely high value for leverage that differs dramatically from the values for leverage of the other cases.

FIGURE 10.3.1 Index plot of leverage vs. case number.

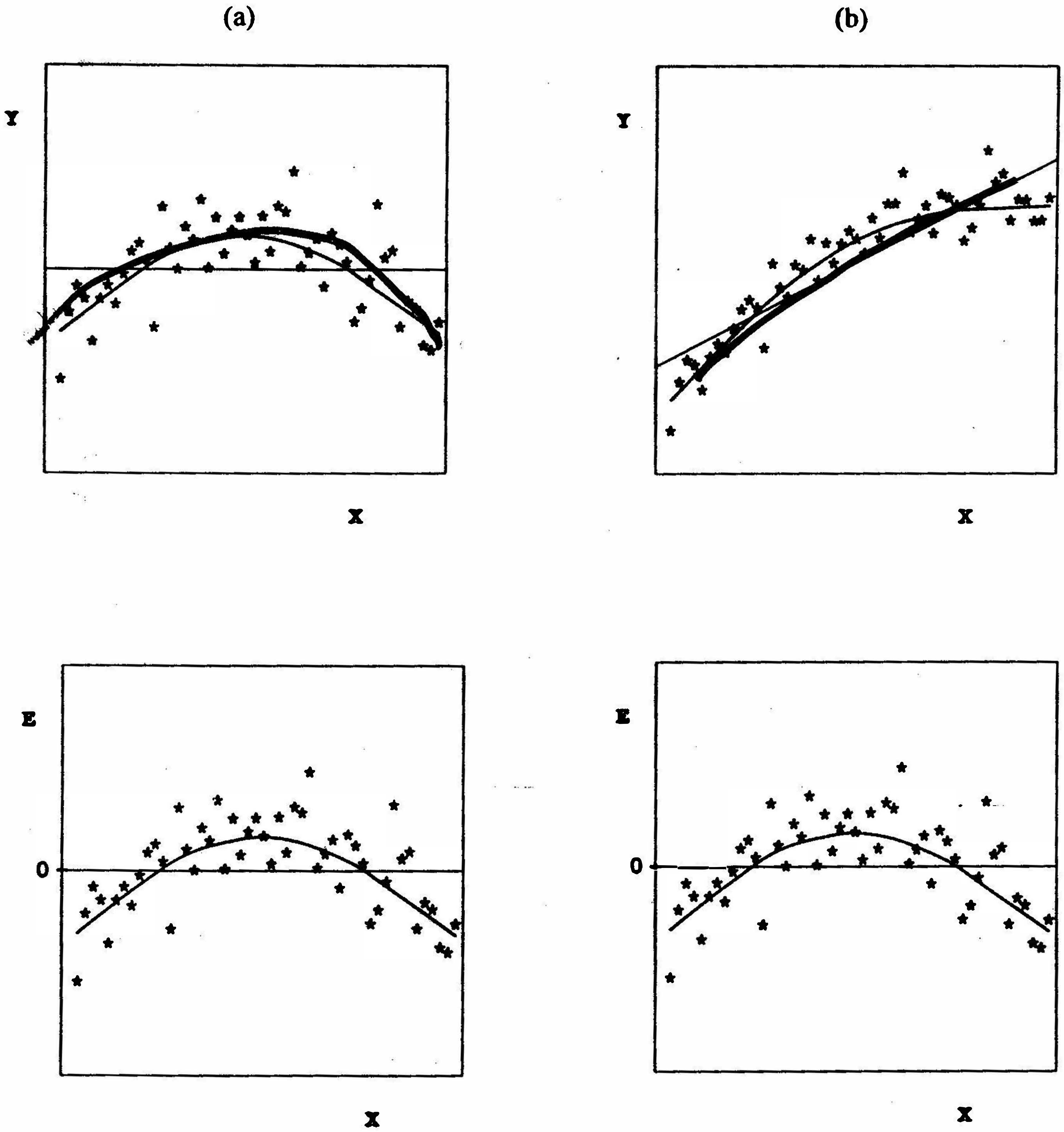


Figure 12.5. The residual plots of E versus X (in the lower panels) are identical, even though the regression of Y on X in (a) is nonmonotone while that in (b) is monotone.

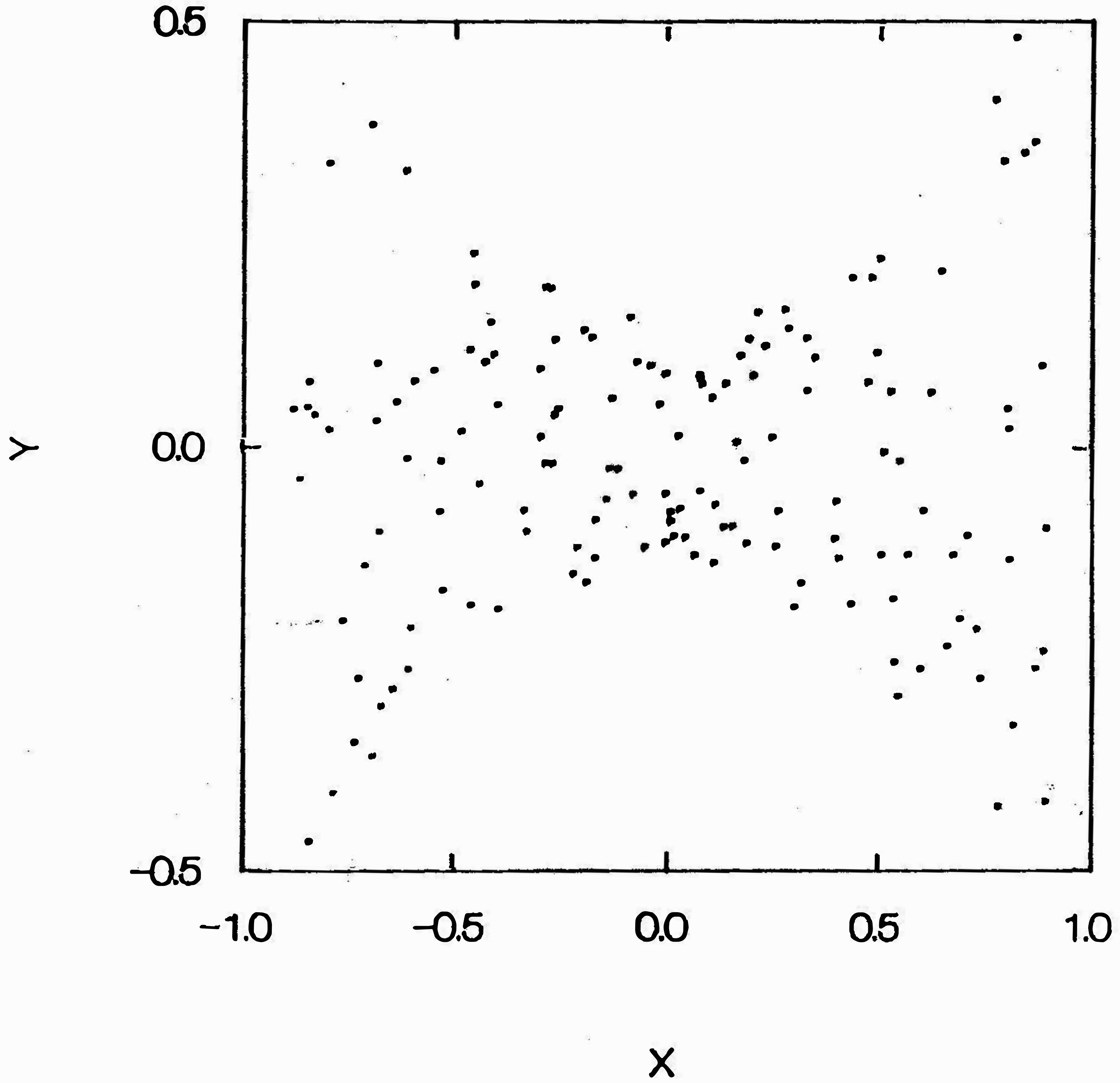
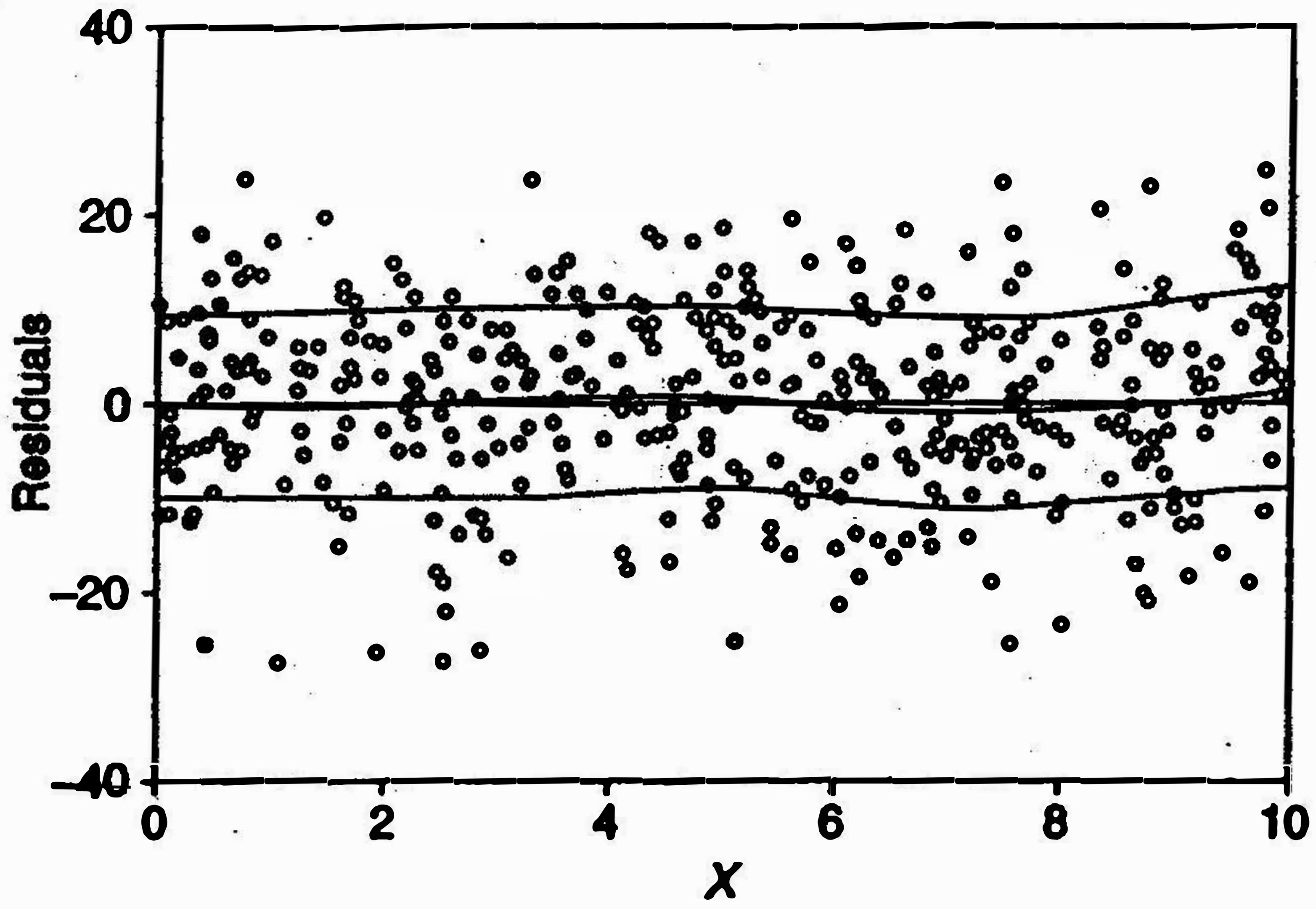
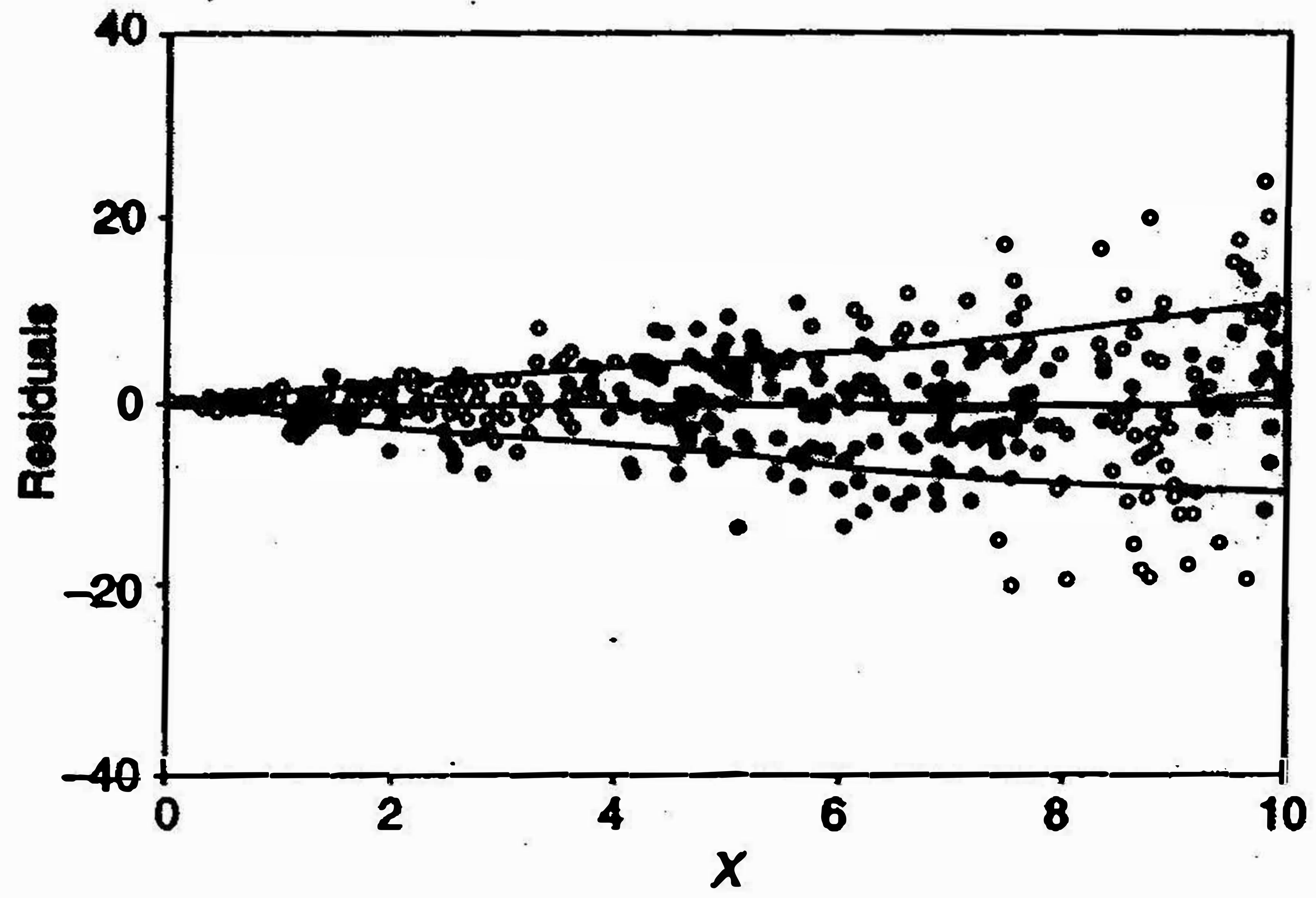


FIGURE 14.4
Butterfly heteroscedasticity.

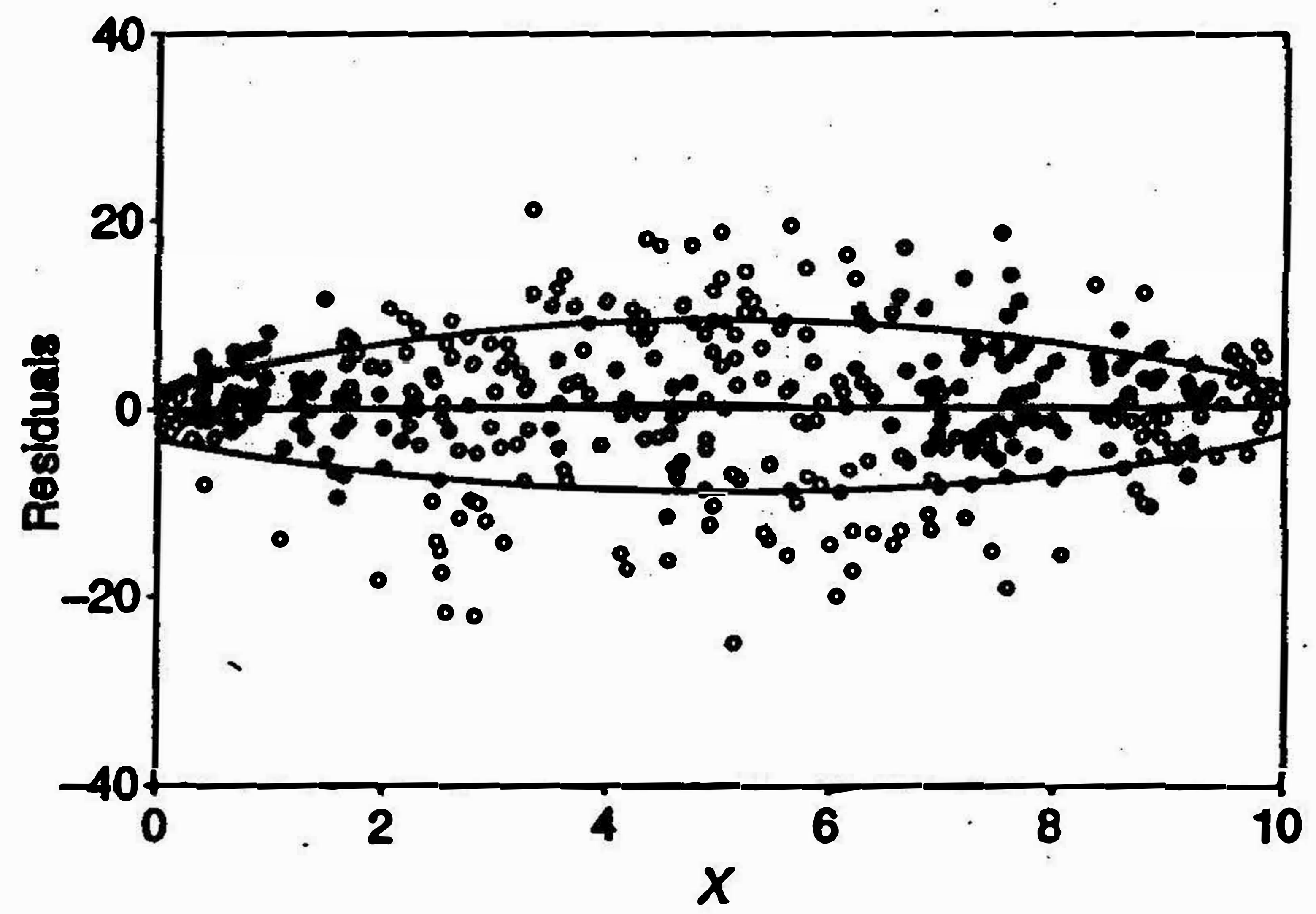
(A) Homoscedasticity (constant varaince)



(B) Heteroscedasticity: variance increases with *X* (right-opening megaphone).



(C) Heteroscedasticity: curvilinear relationship between *X* and variance of residuals.



Note: $n = 400$ cases. The 0-line, the lowess line for the mean, the lowess lines for the mean + 1 *sd*, and the lowess line for the mean − 1 *sd* are superimposed.

FIGURE 4.4.5 Plots of residuals versus *X*. Illustrations of homoscedasticity and heteroscedasticity.

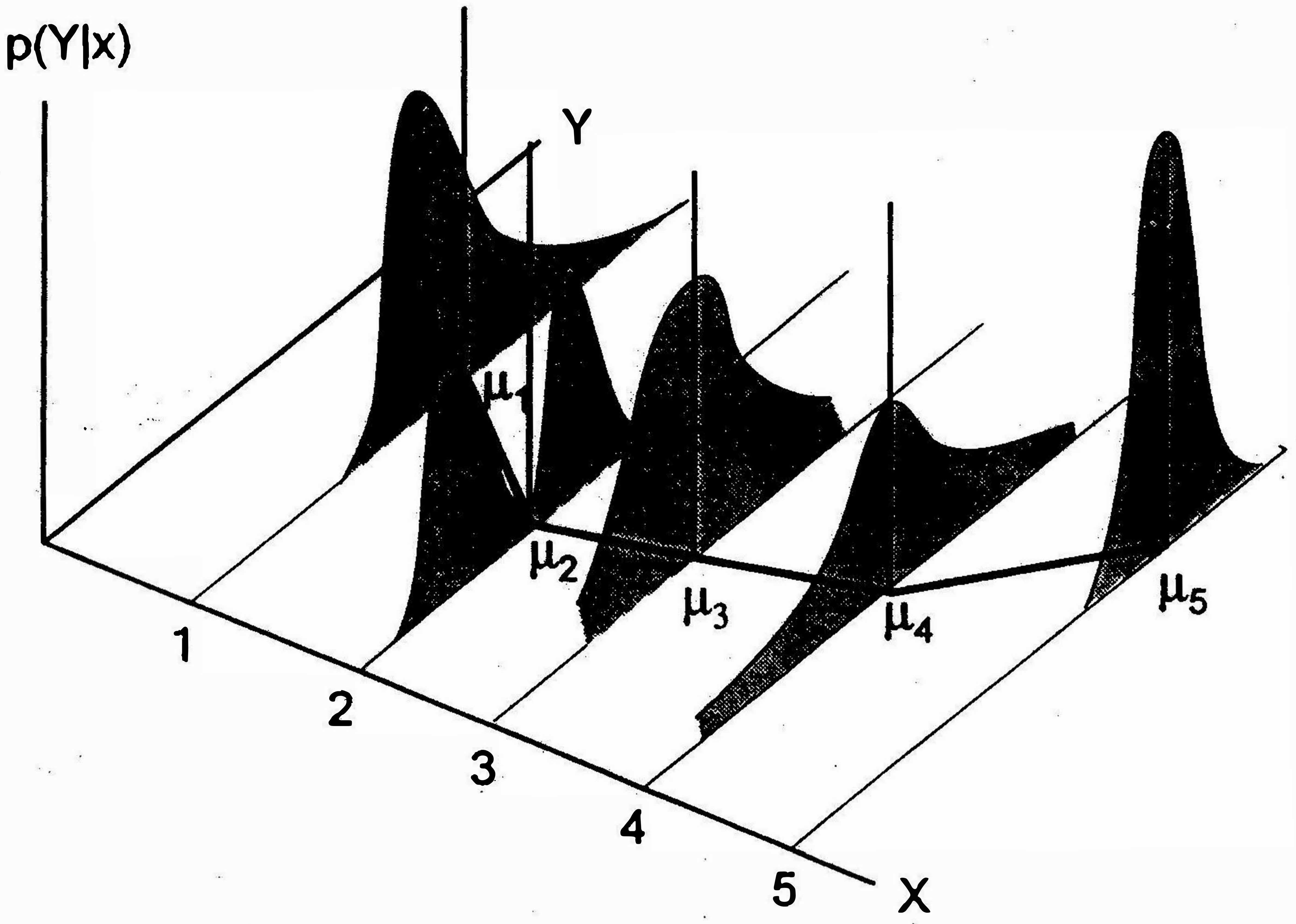


Figure 2.2. Population regression of Y on X. The conditional distribution of Y, $p(Y|x)$, is shown for each of a few values of X. The distribution of Y at $X = 1$ is positively skewed; at $X = 2$ it is bimodal; at $X = 3$ it is heavy tailed; the distribution at $x = 4$ has much greater spread than at $x = 5$. Notice that the conditional means of Y given X—$\mu_1, \ldots, \mu_5$—are not a linear function of X.

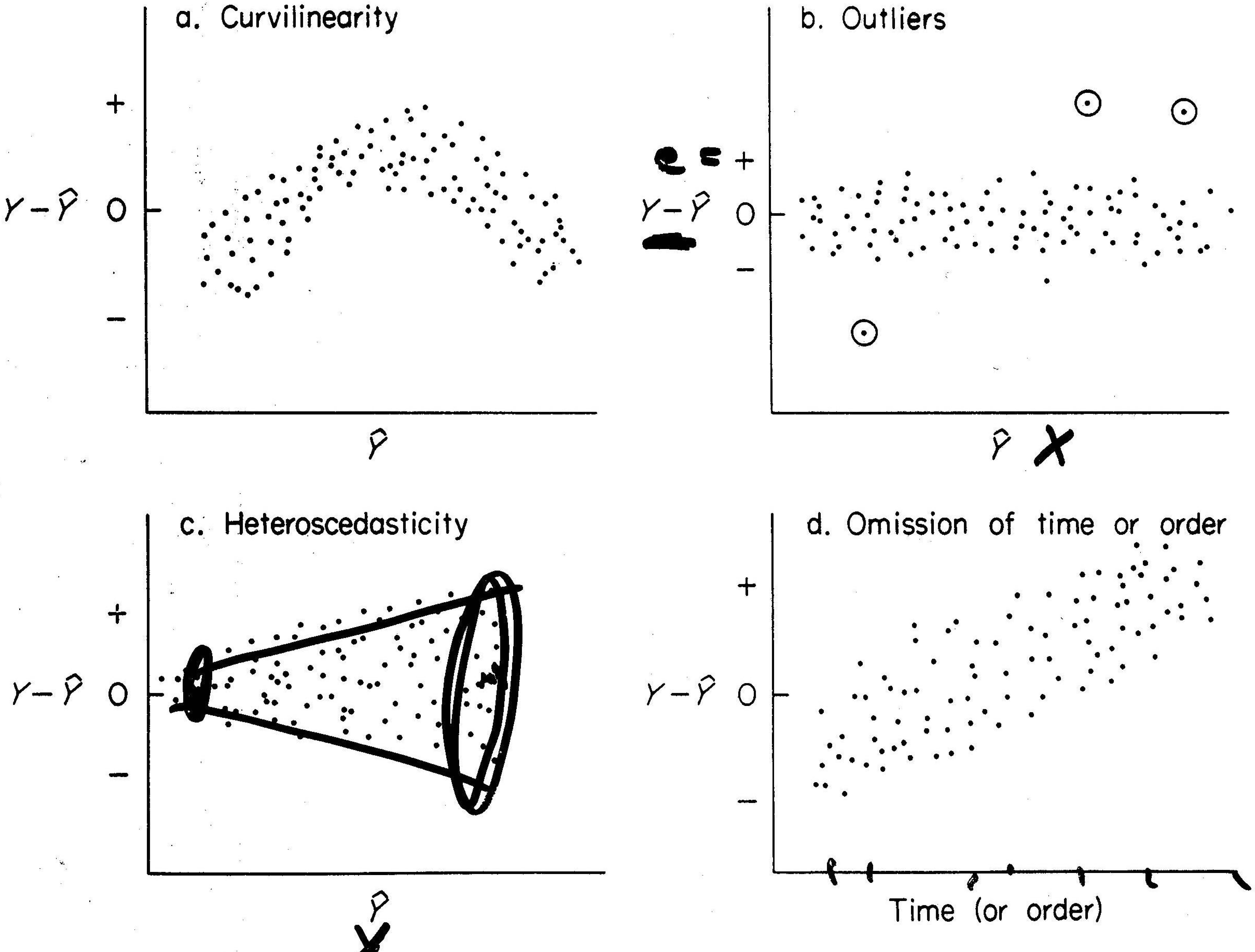
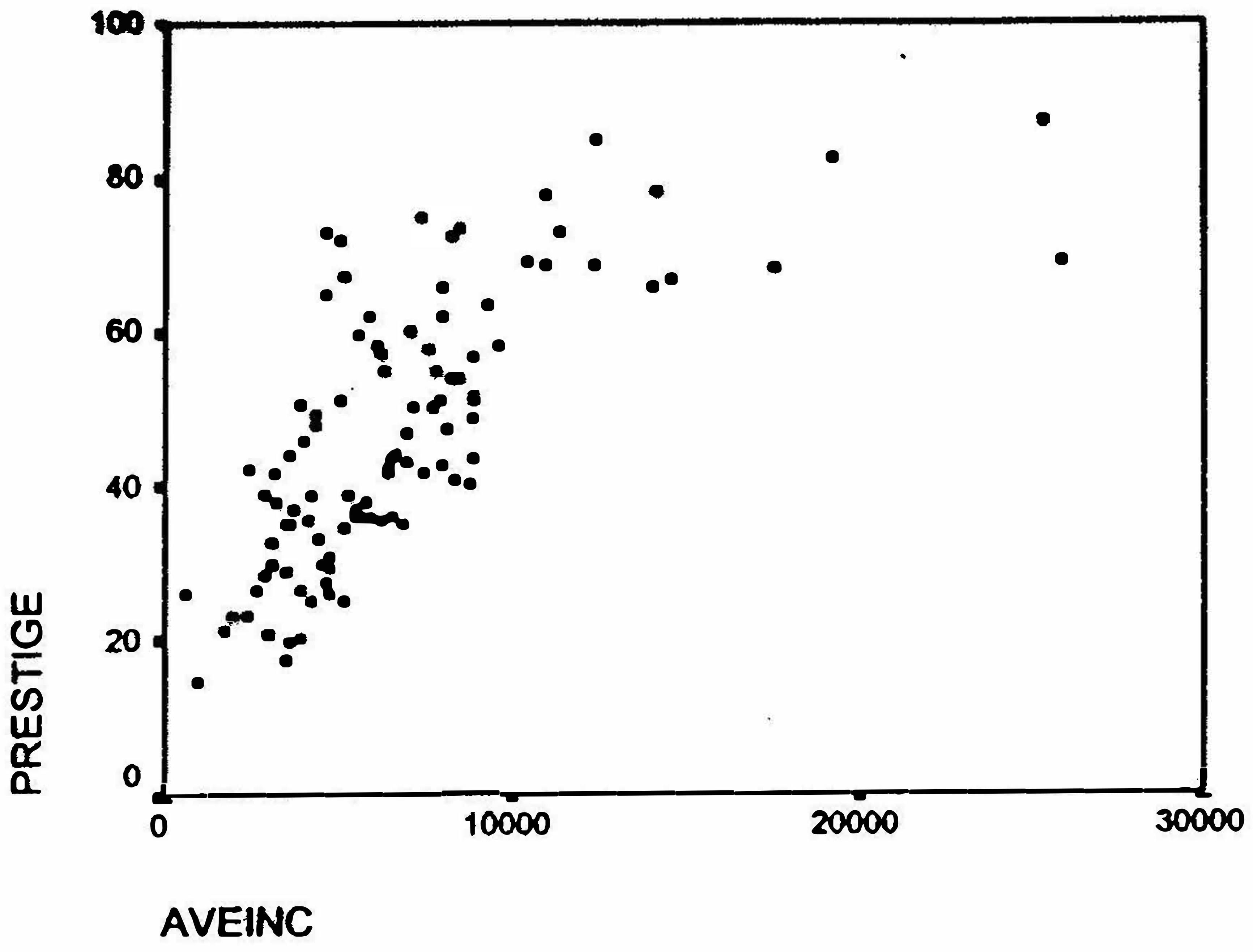
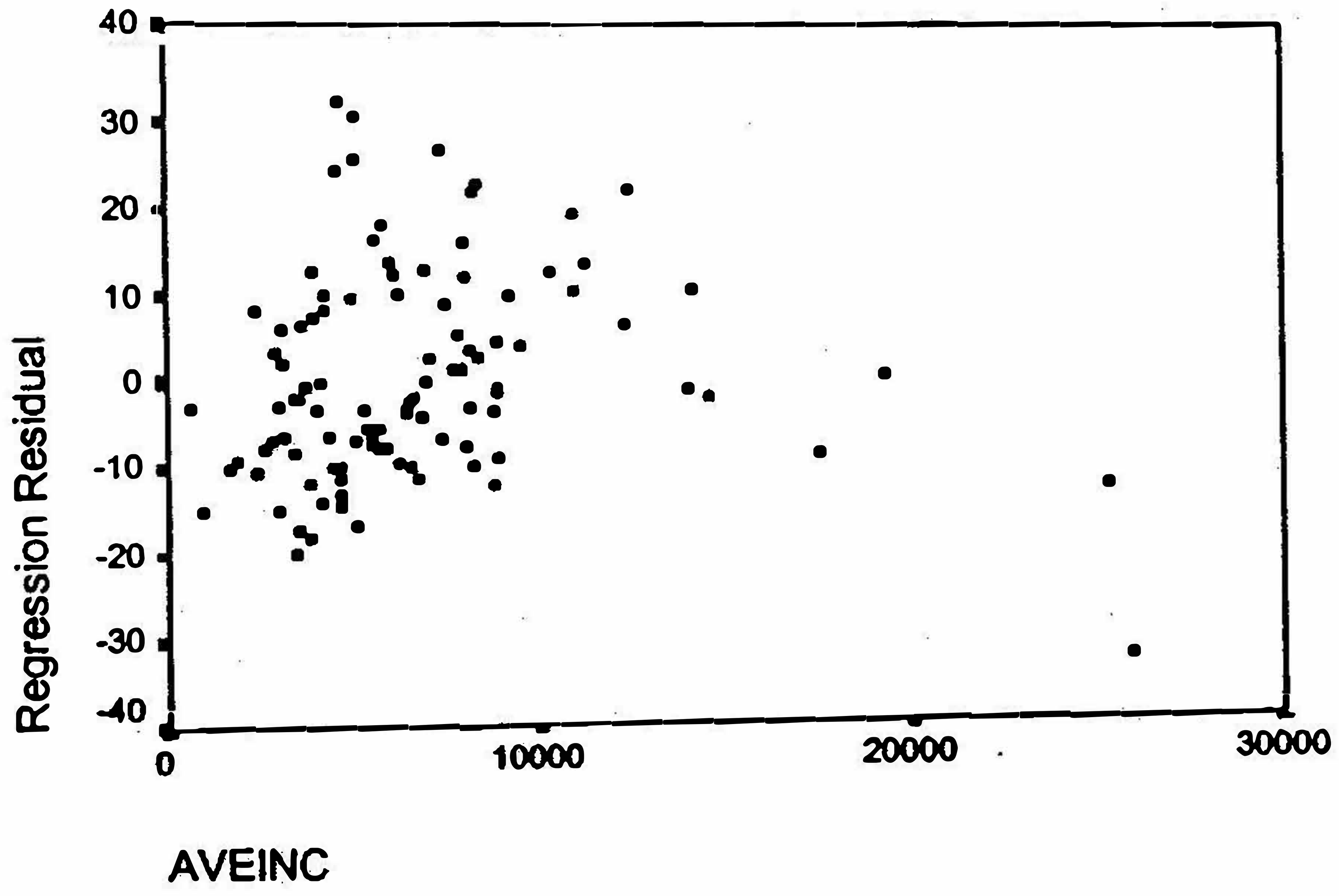


FIGURE 3.9.1 Illustration of four types of model inadequacy. By plotting residuals.

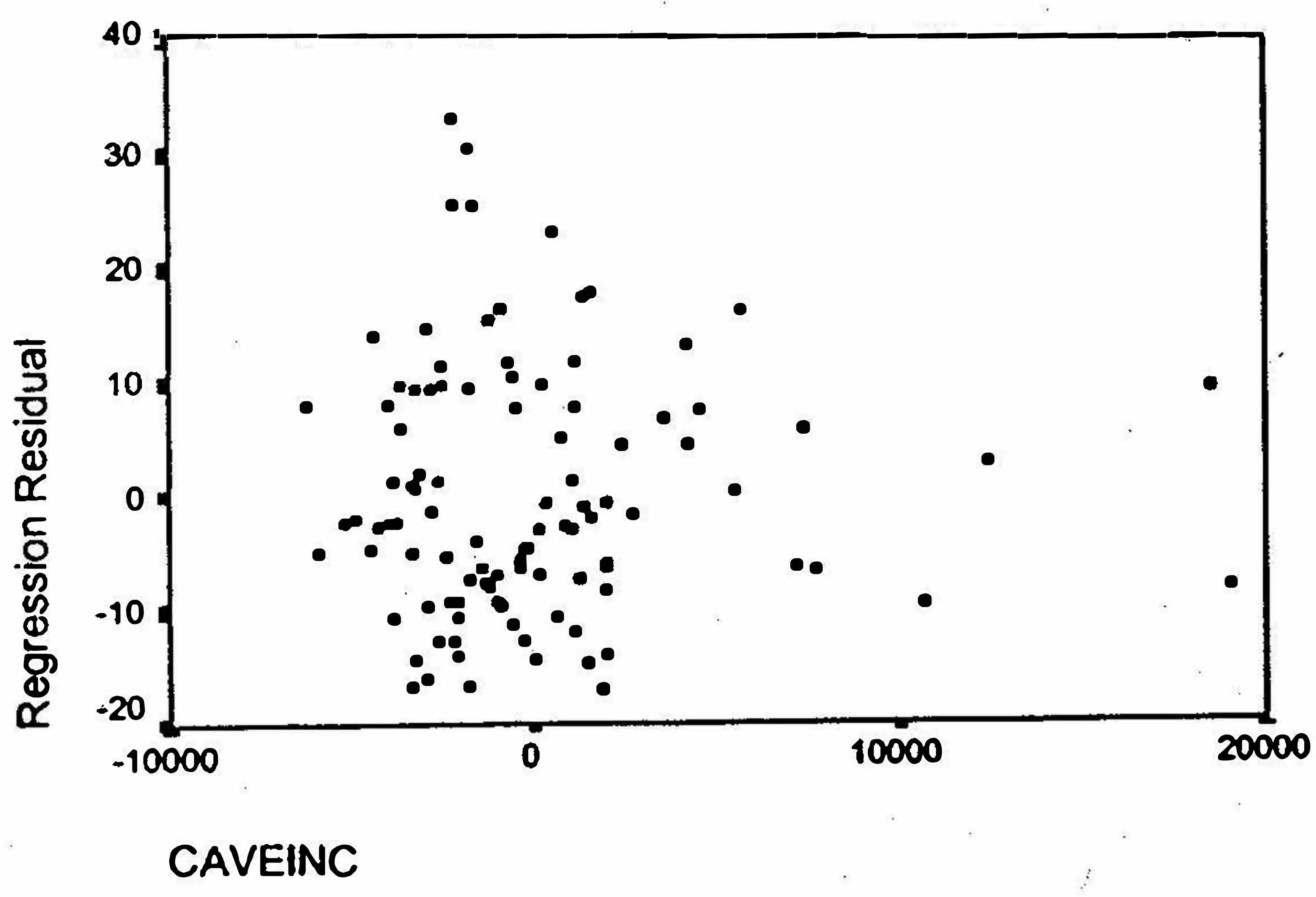
Plot of PRESTIGE with AVEINC



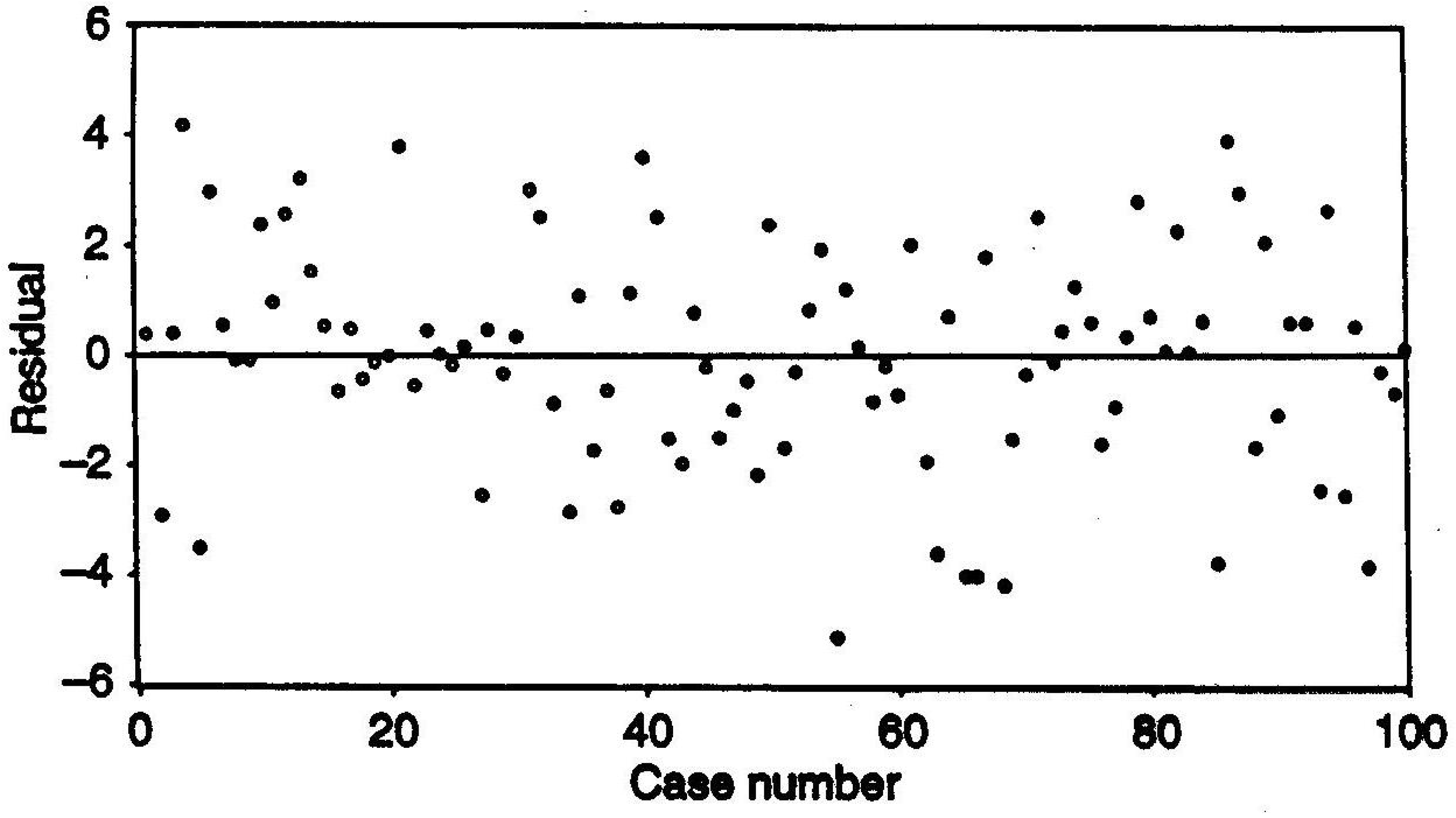
Dependent Variable: PRESTIGE



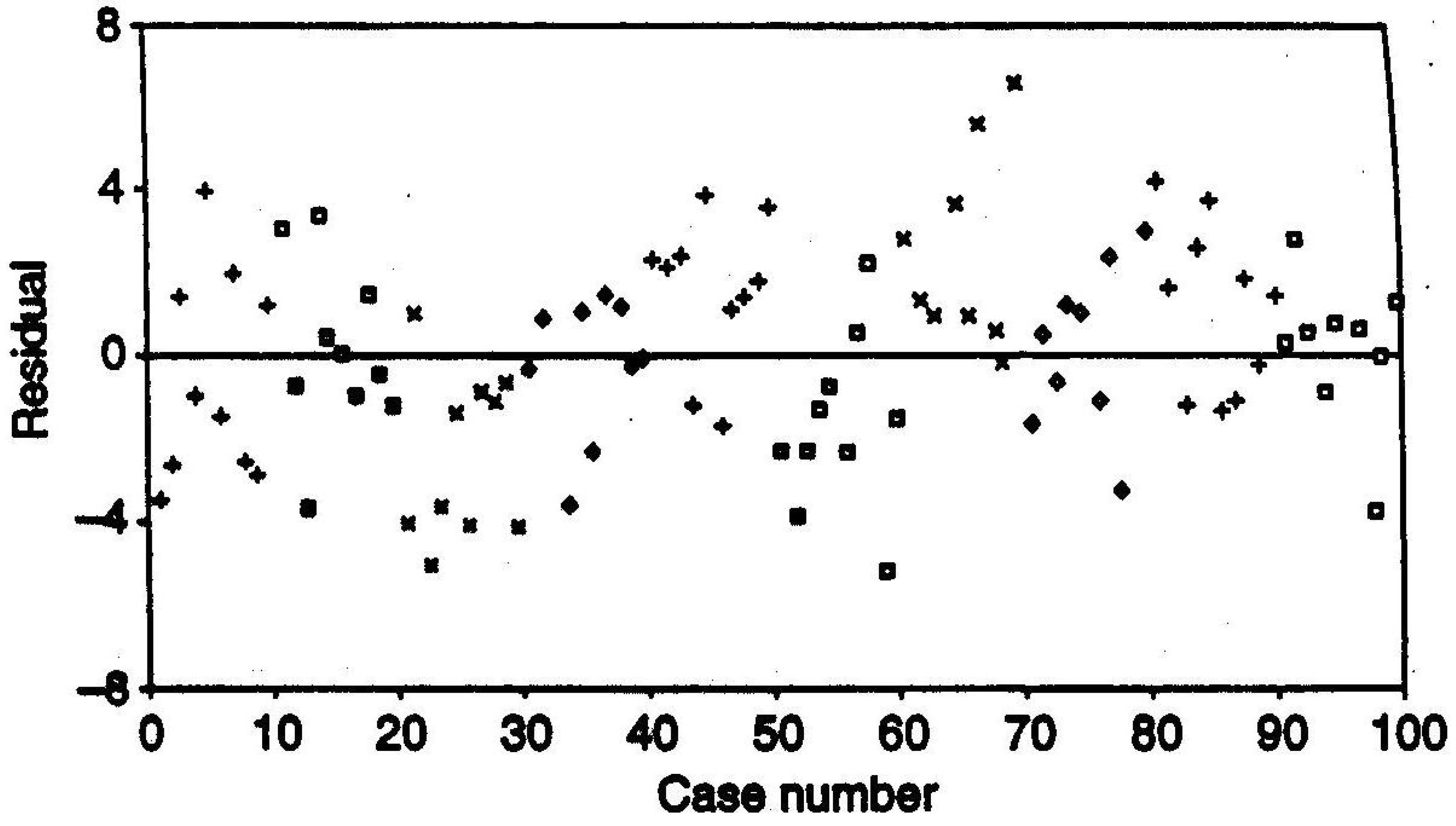
Dependent Variable: PRESTIGE



(A) Independent residuals from a random sample.

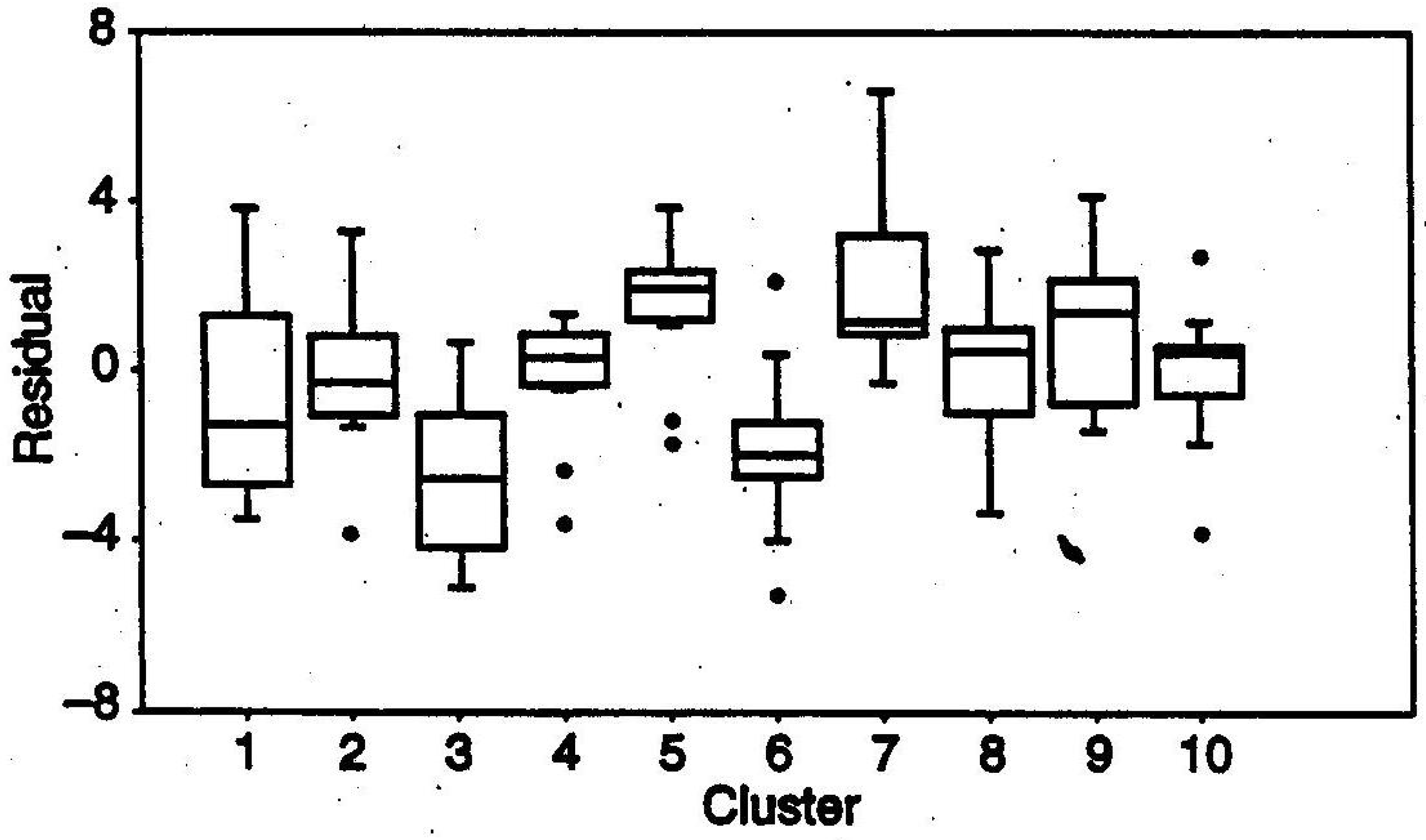


(B) Residuals from clustered data (10 cases per cluster).



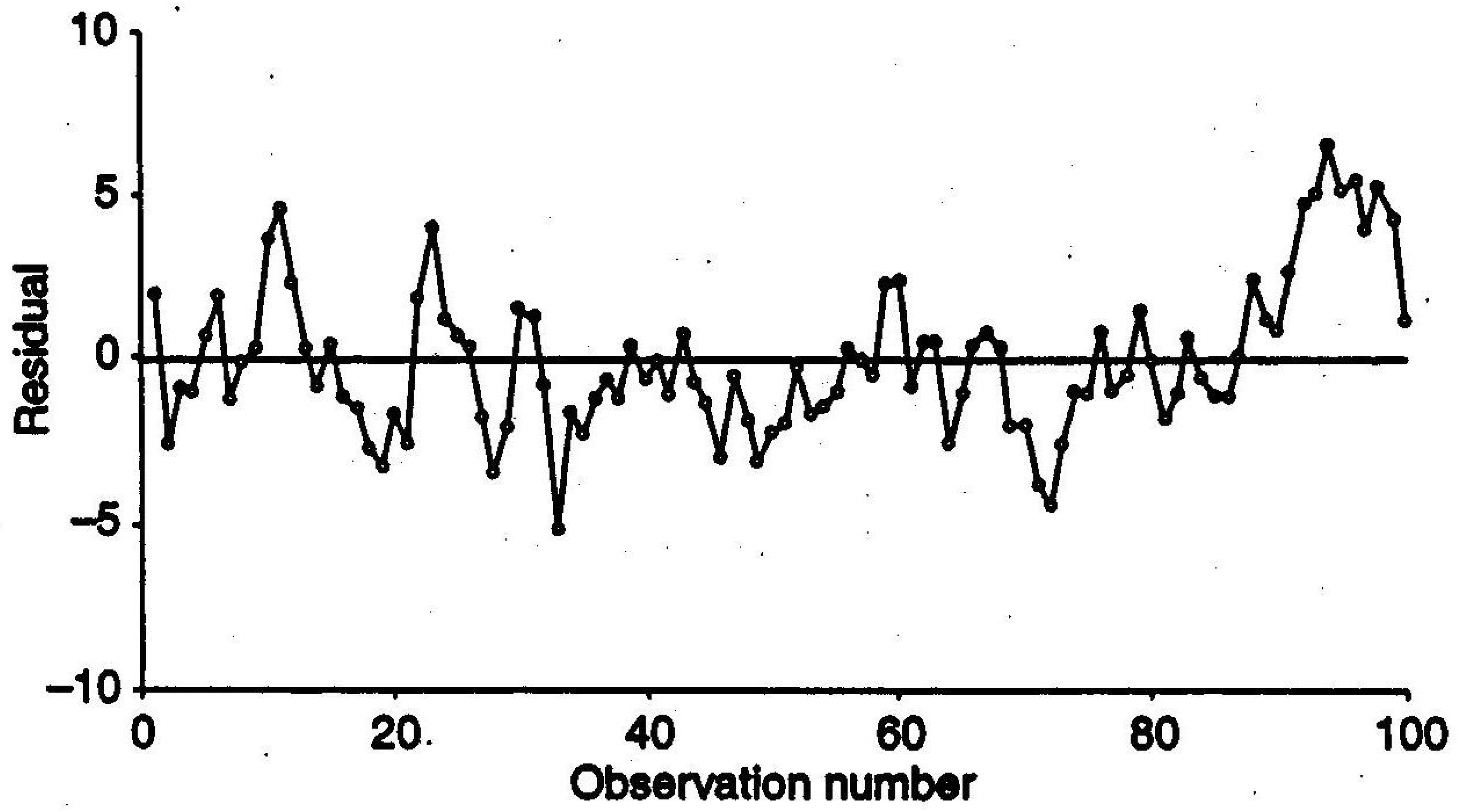
Note: Each cluster of 10 cases (1–10; 11–20; . . .; 91–100) is represented by a different symbol.

(C) Side by side boxplots of the 10 clusters.



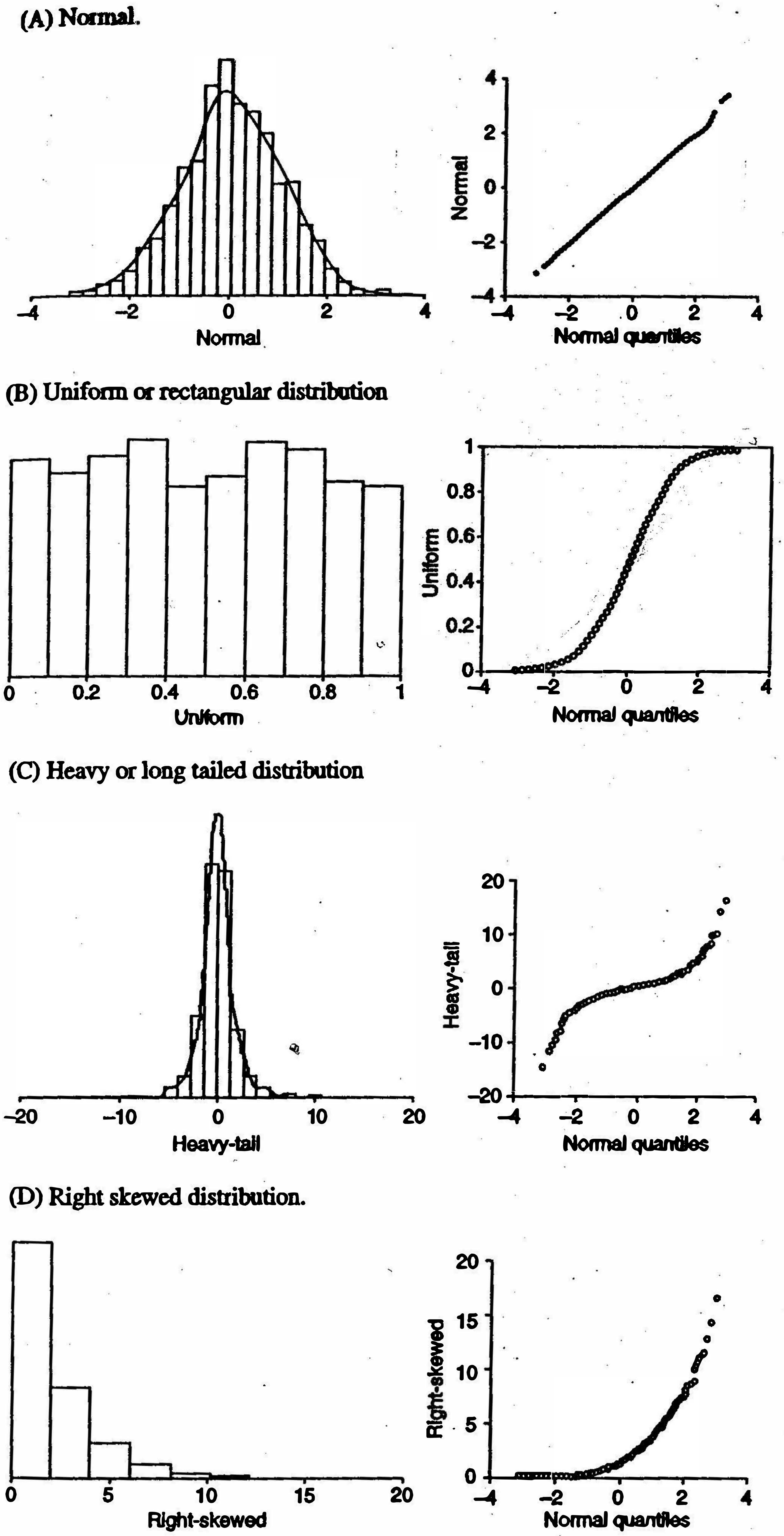
Note: Each boxplot represents a different cluster of 10 cases. The horizontal line in each box represents the median of the cluster. The medians of the 10 clusters show more variation than would be expected by chance.

(D) Autocorrelated residuals ($\rho_1 = .7$).



Note: Observations are equally spaced over time. Temporally adjacent observations are connected by straight lines.

FIGURE 4.4.6 Index plots of residuals.



Note: The histogram are on the left and corresponding q-q plots are on the right in each panel. Kernel density estimates are superimposed on the histograms in (A) and (C). Data sets represent random samples of $n = 1000$ from the following population distributions: (A) normal, (B) uniform, (C) t-distribution, $df = 2$, and (D) chi-square distribution, $df = 2$.

FIGURE 4.4.8 Histograms and q-q plots illustrating some common distributions.

TABLE 10.5.1
Effects of Multicollinearity:
Two-Independent-Variable Example

A. $r_{12} = 0.00; r_{Y1} = .30; r_{Y2} = .40; R^2 = .250.$

Variable	B	SE	pr^2	Tolerance	VIF
Intercept	20.000	0.196			
x_1	0.387	0.114	0.107	1.000	1.000
x_2	0.447	0.098	0.176	1.000	1.000

B. $r_{12} = 0.10; r_{Y1} = .30; r_{Y2} = .40; R^2 = .228.$

Variable	B	SE	pr^2	Tolerance	VIF
Intercept	20.000	0.198			
x_1	0.339	0.116	0.081	0.990	1.010
x_2	0.418	0.100	0.152	0.990	1.010

C. $r_{12} = 0.50; r_{Y1} = .30; r_{Y2} = .40; R^2 = .173.$

Variable	B	SE	pr^2	Tolerance	VIF
Intercept	20.000	0.205			
x_1	0.172	0.138	0.016	0.750	1.333
x_2	0.373	0.119	0.092	0.750	1.333

D. $r_{12} = 0.90; r_{Y1} = .30; r_{Y2} = .40; R^2 = .179.$

Variable	B	SE	pr^2	Tolerance	VIF
Intercept	20.000	0.205			
x_1	−0.407	0.272	0.023	0.190	5.263
x_2	0.765	0.236	0.098	0.190	5.263

E. $r_{12} = 0.949; r_{Y1} = .30; r_{Y2} = .40; R^2 = .224.$

Variable	B	SE	pr^2	Tolerance	VIF
Intercept	20.000	0.199			
x_1	−1.034	0.366	0.076	0.099	10.060
x_2	1.297	0.317	0.147	0.099	10.060

Note: $sd_Y^2 = 5.00; sd_1^2 = 3.00; sd_2^2 = 4.00; M_Y = 20.$