CHAPTER 9

STATISTICAL ANALYSIS OF EXPENDITURES

Just as there were few strong and persistent relationships between the structural variables and local government revenue, expenditures also show a large measure of independence. This chapter, like the last, will look at these relationships through two parts, first a simple correlation analysis, and then a multiple regression analysis. In addition, this chapter will attempt to measure the degree to which expenditures were dependent on revenues, by incorporating revenue as a variable in the multiple regression equations.

Correlation Analysis

All Years Combined

An examination of the correlation coefficients for expenditure categories and the structural variables for the three years combined reveals the familiar pattern of weak relationships. Total per capita expenditure was negatively related to household size (r = -0.55), families (r = -0.55), and under 18 (r = -0.52); the strongest positive relationship is the probably spurious one with dwelling unit age (r = 0.48) (figure 53). For the individual expenditure categories, only culture/leisure had any coefficients equal to or greater than 0.50, and these were the usual negative relationships with household size and families, and the positive one with dwelling unit age. The remaining relationships for expenditure may be marginally

Figure 53: Expenditure Correlations, All Years

	Total Expenditure	General Govt.	Health/ Safety	Community Development	Trans- portation	Water/ Sewer	Culture/ Leisure
Household Size	-0.55	-0.40	-0.33	-0.30	-0.37	-0.34	-0.58
Families	-0.55	-0.41	-0.38	-0.33	-0.21	-0.39	-0.54
Under 18	-0.52	-0.19	-0.41	-0.40	-0.34	-0.33	-0.42
65 and Over	0.12	0.08	0.15	-0.16	0.26	0.13	0.12
Same House	-0.31	-0.17	-0.12	-0.35	-0.14	-0.18	-0.30
Household Income	-0.03	-0.23	0.26	-0.04	0.11	-0.04	-0.37
Poverty	0.09	0.16	0.01	0.06	-0.15	0.12	0.19
Dwelling Unit Age	0.48	0.16	0.43	0.21	0.27	0.38	0.50
Units per Structure	0.21	0.17	-0.04	0.14	0.18	0.13	0.39
White	-0.25	0.12	-0.17	-0.42	0.08	-0.23	-0.24
Manufacturing Jobs	0.12	0.16	-0.05	0.03	0.07	0.05	0.37
Retail/Service Jobs	0.21	0.00	0.01	0.13	0.25	0.21	0.34
Wholesale Jobs	0.27	0.09	0.15	0.20	0.15	0.14	0.42

Source: Data from U.S. Census 1967, 1977, 1987, 1970, 1980, 1990; CA Controller 1970, 1980, 1990

stronger than those for revenue: only 16 of the 91 coefficients for the three years combined were between -0.10 and +0.10.

1990 Correlations

Coefficients for the individual years show some stronger relationship than for the three years combined. In 1990 per capita total expenditure was negatively related to household size, families, and under 18 (as usual), but also to same house (r = -0.60) and the percentage of residential land (r = -0.52). Total expenditure also appears to be positively related to the percentage of industrial land (figure 54).

The individual categories of expenditure also show stronger relationships for 1990 individually than they did for all of the years together (figure 54). General

Figure 54: Expenditure Correlations, 1990

	Total Expenditure	General Govt.	Health/ Safety	Community Development	Trans- portation	Water/ Sewer	Culture/ Leisure
Household Size	-0.57	-0.12	-0.30	-0.30	-0.61	-0.11	-0.61
Families	-0.50	0.11	-0.09	-0.41	-0.41	-0.14	-0.74
Under 18	-0.63	-0.49	-0.39	-0.37	-0.48	-0.09	-0.51
65 and Over	-0.20	0.08	-0.09	-0.54	0.40	-0.16	-0.10
Same House	-0.60	0.02	-0.28	-0.72	-0.02	-0.36	-0.56
Household Income	-0.06	0.38	0.29	-0.21	0.07	-0.17	-0.45
Poverty	-0.17	-0.21	-0.24	0.02	-0.24	-0.12	0.07
Dwelling Unit Age	-0.08	0.14	-0.19	-0.39	0.34	-0.17	0.33
Units per Structure	0.12	-0.58	-0.07	0.17	0.19	0.11	0.37
White	-0.02	0.19	0.06	-0.29	0.40	-0.06	-0.15
Manufacturing Jobs	0.24	0.07	0.03	0.03	0.18	0.11	0.06
Retail/Service Jobs	0.10	-0.29	-0.11	-0.05	0.22	0.39	0.33
Wholesale Jobs	0.38	0.10	0.22	0.20	0.24	0.21	0.46
Residential Land	-0.52	0.01	-0.13	-0.50	-0.10	-0.38	-0.72
Public Facilities Land	-0.43	-0.55	-0.60	-0.29	-0.26	-0.07	0.23
Retail/Wholesale Land	-0.05	-0.58	-0.34	-0.11	0.16	0.46	0.29
Commercial Land	0.33	-0.33	0.18	0.42	0.01	0.22	0.40
Industrial land	0.61	0.42	0.34	0.45	0.24	0.17	0.66
Transp./Utilities Land	0.26	0.12	-0.05	0.36	-0.18	0.29	0.43
Other Land	0.15	-0.34	0.14	0.31	-0.09	0.26	-0.07

Source: Data from U.S. Census 1987, 1990; CA Controller 1990

government expenditure was negatively related to units per structure (r = -0.58), public facilities land (r = -0.55), and retail/wholesale land (r = -0.58). Community development was negatively related to the 65 and over population (r = -0.54), same house (r = -0.72), and residential land (r = -0.50). Health/safety and water/sewer expenditures show no correlation above the 0.50 threshold level, while transportation exceeds that level only for household size (r = -0.61).

Culture/leisure expenditure was negatively related to households, under 18, same house, families, and residential land. The strength of the last two coeffi-

cients (r = -0.74 for families and r = -0.72 for residential land) is very interesting. Since the relationships for these two variables was much stronger than the usual negative relationship with the other expenditure categories, there was some connection between families and residential neighborhoods and culture/leisure spending. This was exactly the opposite of what would be expected, i.e., that families would expect more parks, museums, and recreation programs. Culture/leisure spending also showed a surprising positive relationship with manufacturing jobs and industrial land.

1980 Correlations

Some of the correlation coefficients for 1980 were similar to those for 1990, but there were also significant differences (figure 55). Culture/leisure expenditures were negatively related to household size and families, but the positive relationship with manufacturing employment was gone. General government also showed a strong negative relationship with household size and families; total expenditures a weaker one. Health/safety and water/sewer expenditures were unrelated to anything, while transportation was related only to same house (r = -0.65), unlike 1990, when this correlation coefficient was (r = -0.02). For 1980 there was a positive relationship between the poverty rate and all categories of spending, although only for general government does it rise above r = 0.50.

1970 Correlations

Turning to 1970, we again find weak relationships, but also some surprises (figure 56). The strong relationship between culture/leisure expenditures and families that we found in 1990, did not exist in 1970 (figure 56). Culture/leisure expenditures were instead, negatively related to household income

Figure 55: Expenditure Correlations, 1980

	Total Expenditure	General Govt.	Health/ Safety	Community Development	Trans- portation	Water/ Sewer	Culture/ Leisure
Household Size	-0.45	-0.72	-0.14	-0.34	-0.17	-0.32	-0.57
Families	-0.52	-0.81	-0.18	-0.41	-0.17	-0.41	-0.63
Under 18	-0.22	-0.44	-0.07	-0.24	0.02	-0.08	-0.34
65 and Over	-0.03	0.17	-0.05	-0.09	-0.36	-0.04	0.10
Same House	-0.42	-0.25	-0.28	-0.39	-0.65	-0.34	-0.25
Household Income	-0.23	-0.55	0.13	-0.20	-0.16	-0.19	-0.37
Poverty	0.41	0.64	0.13	0.37	0.02	0.43	0.42
Dwelling Unit Age	0.38	0.56	0.33	0.23	-0.40	0.31	0.56
Units per Structure	0.15	0.52	-0.16	0.13	0.19	0.07	0.23
White	0.10	-0.02	0.18	0.07	0.12	0.02	0.09
Manufacturing Jobs	-0.06	0.00	-0.10	0.10	-0.14	-0.09	0.09
Retail/Service Jobs	-0.08	0.32	-0.27	-0.08	-0.09	-0.14	0.05
Wholesale Jobs	0.13	0.09	0.08	0.31	0.02	0.09	0.21

Source: Data from U.S. Census 1977, 1980; CA Controller 1980

(r = -0.62) and positively related to all three measures of employment and to units per structure. Similarly, the relationship between household size and transportation expenditures that was prominent in 1990, did not exist in 1970. Dwelling unit age, which in 1990 was unrelated to total income, had shown a definite positive relationship in 1970 (r = 0.51). The usual negative relationships between expenditures and household size and families were found in 1970 for total per capita expenditures, general government, health/safety, and community development. The radical difference in the correlation between families and culture/leisure expenditures between 1970 and 1990, coupled with the divergence of the families and household size coefficients for 1970 indicates that there may be a significant effect of families on expenditure, separate from the effects of household size (as discussed in chapter 8).

Figure 56: Expenditure Correlations, 1970

	Total Expenditure	General Govt.	Health/ Safety	Community Development	Trans- portation	Water/ Sewer	Culture/ Leisure
Household Size	-0.39	-0.58	-0.10	-0.33	0.04	-0.06	-0.48
Families	-0.61	-0.53	-0.69	-0.64	0.34	-0.35	-0.19
Under 18	-0.10	-0.12	-0.07	-0.02	0.01	-0.11	-0.01
65 and Over	0.25	0.16	0.16	-0.08	0.11	0.31	0.16
Same House	0.01	-0.23	0.13	0.09	-0.03	0.15	-0.07
Household Income	-0.18	-0.47	0.21	-0.38	0.30	0.11	-0.62
Poverty	0.43	0.36	0.47	0.39	-0.17	0.17	0.27
Dwelling Unit Age	0.51	0.33	0.53	0.38	0.05	0.30	0.23
Units per Structure	0.27	0.49	-0.18	0.12	0.00	0.02	0.68
White	-0.05	0.00	0.12	-0.11	0.11	0.02	-0.48
Manufacturing Jobs	0.42	0.42	-0.08	0.35	0.18	0.30	0.66
Retail/Service Jobs	0.26	0.44	-0.18	0.13	0.25	-0.09	0.66
Wholesale Jobs	0.02	0.15	-0.07	0.38	-0.15	-0.04	0.74

Source: Data from U.S. Census 1967, 1970; CA Controller 1970

Meaning of the Correlation Analysis

The impermanence of the relations between the social and economic structure and expenditure categories was demonstrated by the shifting correlation coefficients here. There are two possible reasons for these changes: (1) there were no real relationships being measured; all correlations whose signs change and magnitudes shift are spurious, the result of chance or associations with other factors; or (2) there were real relationships, but these relationships change over time; while population and economic characteristics do create demands for government expenditures, the way in which government responds to these demands is itself a variable that cannot be measured from the data here. Most likely, both of these factors were at work in the changing relationships shown by this correlation analysis. The regression analysis to follow will also look at one additional

possibility, that expenditures were at least partially dependent on revenues, so that the relationships between expenditures and structural variables were mediated through the relationships between these variables and revenues discussed in chapter 8.

Multiple Regression Analysis

The multiple regression analysis of expenditures was carried out in two phases: (1) using only those independent variables employed in the analysis of revenue; and (2) using total revenue per capita as an independent variable in addition to those used to measure revenue. There are two reasons for incorporating revenue as an independent variable: (1) revenue may be an independent factor in determining how much is spent, i.e., if they have it, they will spend it; and (2) due to the possible linkage of revenue with spending, some independent variables may appear to be affecting expenditure, when in fact their actual effect is on revenue, which then affects expenditure. By incorporating revenue as an independent variable, we can measure the separate effects of these variables on expenditure.

Expenditure Analysis--Revenue Excluded

Figure 57 shows the results of the multiple regression analysis, without including revenue as an independent variable. All four equations had about the same predictive power; the values for R^2 were all between 0.60 and 0.67. All of the equations, except for 1970, were significant at the 0.05 level. The regression coefficients for the individual variables, however, present several important differences.

Figure 57: Expenditure Regression

	All Years	1970	1980	1990
Adjusted R^2	0.62	0.60	0.67	0.65
Standard Error	0.60	0.39	0.36	0.42
Observations	54.00	17.00	18.00	19.00
Significance F	0.00	0.06	0.20	0.20
Regression Coefficients				
Household Size	-0.23	1.33 *	-3.58 **	-0.73
Families	-0.36 *	-0.68 *	3.25 **	0.46
Under 18	0.27	0.17	0.43	0.92
65 and Over	-0.16	0.29	-0.10	0.44
Same House	-0.70 **	-0.49	-1.36 **	-2.03 **
Household Income	0.61 **	0.12	0.44	0.84 **
Poverty	-0.23	0.13	0.16	-0.61
Dwelling Unit Age	0.63 **	0.93	1.36 *	0.52
Units per Structure	0.02	0.68 *	0.13	0.17
White	-0.06	0.21	-0.73 *	-0.13
Manufacturing Jobs	0.11	0.93 **	-0.50 *	-0.07
Retail/Service Jobs	-0.07	0.22	-0.46 *	-0.37
Wholesale Jobs	0.22	-0.55 **	0.64 **	0.54 **

* Significant at 0.05 level

** Significant at 0.01 level

Source: Data from U.S. Census 1967, 1977, 1987, 1970, 1980, 1990; CA Controller 1970, 1980, 1990

The equation for all years combined was similar to the results for revenue: families and same house were significantly negative; household income and dwelling unit age were significantly positive. If expenditure was dependent on revenue, then the expenditure regression may be simply measuring the effects of these variables on revenue, in a slightly different way. The expenditure regression coefficient for wholesale jobs was similar in magnitude to the revenue regression coefficient, but, while it was significant in the revenue equation, it was not in the expenditure equation.

The set of significant coefficients for the 1970 expenditure regression was almost completely different from that for all years combined: only families was significant in both equations. Manufacturing jobs was significantly positive for 1970, while wholesale jobs was significantly negative. Units per structure and household size were also significantly positive. The overall regression equation, however, was not statistically significant by the *F* test.

For 1980 there was a dramatic reversal of the effects of manufacturing and wholesale jobs: manufacturing was now significantly negative, while wholesale jobs was significantly positive. Retail/service jobs was also significantly negative, along with the white population. (White population had also been a significant negative factor in the 1980 revenue regression.) Same house and dwelling unit age both appear to have much stronger effects in 1980 than for 1970 and overall, but the direction of the effects was the same in all cases. Families showed a positive effect for 1980, compared to a negative effect in 1970 and overall, while household size showed a strong negative effect. This result should be interpreted with caution, however, due to the close association of families and household size in 1980. It should be noted that the combined effects of families and household size were negative in all cases.

By 1990 the negative effect of same house had become even stronger, reflecting the same result that was found in the revenue regression. Household income also showed a stronger effect than for prior years and was now significant. The only other significant factor in 1990 was wholesale employment, with a positive sign consistent with 1980. Manufacturing employment was no longer significant, and its coefficient was, in fact, very close to 0.0.

Expenditure Analysis--Revenue Included

The similarities between regression coefficients for the expenditure regression and the revenue regression indicate that the expenditure regression may be partially measuring the effects of the independent variables on revenue, which then in turn affects expenditures. Figure 58 shows the results of incorporating per capita revenue as an independent variable, in order to separate out this effect.

For all three years combined, the addition of revenue as an independent variable boosts the Adjusted R^2 from 0.62 to 0.92. The addition of revenue to the equation explains 79% of the previously unexplained variation and the standard error was cut in half. Revenue was the most powerful explanatory variable (measured by the regression coefficient), and it was significant at the 0.01 level.

Several changes occurred in the individual regression coefficients when revenue was added as an independent variable. The most significant change was that families was now a significant positive factor, indicating that the previously measured negative effect was actually capturing the effect of families on revenue, and that when revenue was held constant, a higher percentage of families was associated with higher expenditures. Dwelling unit age remains a significant positive factor, but units per structure emerges as a new positive factor. When revenue was not included, units per structure was not significant and was very close to 0.0. Same house and household income were no longer significant in their effects on expenditure, when revenue was taken into account.

The employment variables had more significant effects on expenditure when revenue was taken into account. Manufacturing employment had the same regression coefficient for both equations, but it was statistically significant when

Figure 58: Expenditure Regression, Including Revenue

	All Years	1970	1980	1990
Adjusted R^2	0.92	0.49	0.74	0.74
Standard Error	0.24	0.42	0.10	0.25
Observations	54.00	17.00	18.00	19.00
Significance F	0.00	0.14	0.00	0.01
Regression Coefficients				
Household Size	0.01	1.19	0.33	-0.26
Families	0.42**	0.08	1.10*	-0.47
Under 18	-0.10	-0.16	-0.07	0.05
65 and Over	-0.09	0.11	-0.04	-0.11
Same House	-0.13	-0.55	-0.41*	0.72
Household Income	-0.06	-0.16	-0.42*	-0.11
Poverty	-0.01	-0.06	0.00	0.05
Dwelling Unit Age	0.29**	0.91	0.62**	-0.07
Units per Structure	0.20**	0.53	0.73**	-0.21
White	0.09	0.06	0.18	-0.35
Manufacturing Jobs	0.11*	0.76*	0.15	-0.05
Retail/Service Jobs	0.04	0.20	-0.03	0.11
Wholesale Jobs	-0.11*	-0.51*	-0.26*	-0.04
Per Capita Revenue	1.02**	0.74	1.13**	1.11**

* Significant at 0.05 level

** Significant at 0.01 level

Source: Data from U.S. Census 1967, 1977, 1987, 1970, 1980, 1990; CA Controller 1970, 1980, 1990

controlling for revenue. Wholesale employment was significantly negative, but retail/service jobs was still unrelated to expenditure levels.

The addition of revenue as an independent variable to the 1970 expenditure regression actually reduces the Adjusted R^2, and the resulting equation was even less significant by the *F* test. Revenue was not significant at the 0.05 level; in fact, the only two significant variables were manufacturing employment and wholesale employment. Although the signs of all the coefficients (and in some cases the magnitudes) were consistent with those for the combined regression, the poor

statistical significance of this equation indicates that these results may be due to chance.

The adjusted R^2 for 1980 was only increased from 0.67 to 0.74 by the addition of revenue as an independent variable, but the standard error was reduced by two-thirds, and revenue was the most powerful explanatory variable. The coefficients for families, dwelling unit age, units per structure, and wholesale jobs were consistent with the combined regression, but the magnitudes were even stronger. Same house and income were both stronger and reach a level of significance in 1980 that they did not attain for the combined regression. Manufacturing jobs was no longer significant.

Should we conclude that there was a consistency in the relationships of structural variables to expenditure, once revenue differences were taken into account, an examination of the results for 1990 should shatter that expectation. The addition of revenue to the 1990 equation increases Adjusted R^2 from 0.65 to 0.74 and cuts the standard error almost in half, but revenue was now the only significant variable. The consistent magnitude for the revenue variable (except for 1970) and its high level of statistical significance indicate that it was a major factor in determining the level of expenditures, but what of the other variables?

Of 13 independent variables, nine showed a different sign in 1990 than they had in 1980. Families, dwelling unit age, and units in structure were significant positive factors in 1980, but were negative (although not significant) in 1990. Same house, which had been significantly negative in 1980, was a positive factor in 1990. Of all the statistically significant variables in 1980, only household income

and wholesale jobs had the same sign in 1990, but neither of these maintained its level of significance.

Meaning of the Regression Analysis

The foregoing analysis should once again illustrate the dangers of assuming that expenditures can be predicted based on the demographic and economic structure of the community: what would be an accurate prediction model for one year may not work 10 years later. Given the radical reversal of effects from 1980 to 1990 and the insignificance of the 1970 equation, it is difficult to see how the combined regression achieved such a high level of predictive power. The conjunction of the combined results with those for 1980 indicates that the combined equation would work reasonably well at the midpoint of the period (1980) but not at the extremes. Once again significant changes have occurred over time, and we can have little confidence in our ability to create regression models to predict expenditure. In fact, the only reasonable conclusion to draw is that in recent years (1980 and 1990) expenditure was heavily dependent on the amount of revenue coming in. (Except for the combination of all years, we can actually achieve a higher value of Adjusted R^2 by using a regression equation with per capita revenue as the only independent variable. Values for this extremely simplified model were: Combined, Adjusted $R^2 = 0.86$; 1970, Adjusted $R^2 = 0.54$; 1980, Adjusted $R^2 = 0.91$; 1990, Adjusted $R^2 = 0.86$. All of these equations were significant at 0.001 by the F test.)