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EVALUATING THE SETTLEMENT OF THE LOS ANGELES REGION: A STUDENT PROJECT

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Introduction

The fragmented, urban landscape of the Los Angeles region has a built-up area of 1,700 square miles. Only the New York metropolitan region has a greater area. Physiographically, the Los Angeles region encompasses the Coastal Plain and adjacent lowlands of Southern California (Figure 1). To the casual observer, the region's large area tends to disguise the importance of location-specific, environmental and cultural relationships which have influenced the timing and spread of settlement in the area. Any instructor who has addressed the historical settlement of the Los Angeles region knows the frustration inherent in trying to reduce the complexity of this urbanized landscape to a level of generalization that students can understand.

A review of some of the approaches used by scholars will help clarify this problem. Lantis, Steiner, and Karinen subdivide the Los Angeles region physiographically and sketch the history of settlement for each division.[1] Steiner emphasizes a topical approach by describing salient social, economic, and environmental factors that have led to the decentralization of urban functions and the rise of selected sub-regions.[2]

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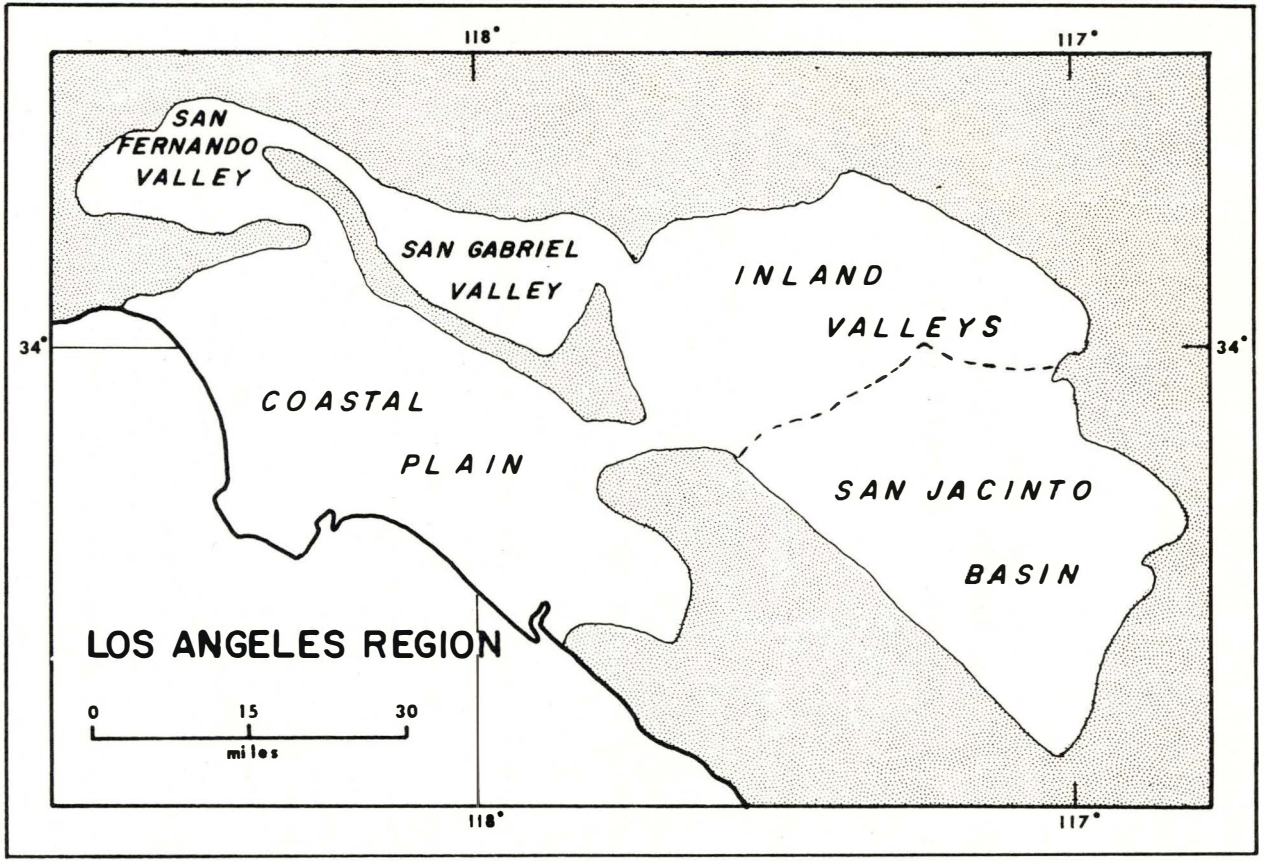

Figure 1. Map of the Los Angeles region (lowlands)

Aschmann[3] and Fogelson[4] also use topical approaches, and both focus on the importance of human perceptions and purposes in the evolution of the region's fragmented landscape. On the other hand, the historians Bigger and Kitchen[5] use a chronological approach in providing the background of city formation. Still others have dealt with the evolution of the architectural landscape. Banham, for example, provides a delightful treatment of this topic by subdividing the Los Angeles region into Surfurbia, Foothills, Plains of Id, and Autopia.[6]

Each of these approaches has made valuable contributions toward understanding how the Los Angeles metropolitan landscape developed.[7] Nevertheless, by themselves, they are inadequate pedagogical tools for use in teaching about areal settlement trends. The sub-regional approach often can frustrate students' efforts to cross-reference details about the timing of population growth and settlement for the entire region. On the other hand, topical and chronological approaches can be too narrow in scope, so that while some aspects that influence the timing and spread of settlement are adequately addressed, others are not chosen for examination.

Purpose

This paper focuses on the proposed use of a trend surface computer map as a heuristic device for the study of an evolving urban landscape. The specific purpose is to suggest how an instructor can use such a map to help students make generalizations and state hypotheses regarding locational relationships which may have shaped the timing and spread of settlement in the Los Angeles region.

Theoretical Considerations

Two assumptions serve as a basis for the following discussion. The first is based on the fact that city incorporation usually signifies that a community's population is growing at such a fast rate that its members have decided a city government is

needed in order to formulate public policy and provide services. Therefore, it is assumed that the years in which cities are incorporated are good indicators of population growth; and, if the dates of incorporation are plotted on a map at their respective city locations, a time-dimension trend in settlement can be discerned. Figure 2 comprises such a map. It is based on all of the cities which were incorporated in the Los Angeles region between 1850 and 1940. The year 1850 was the date of the first city to be incorporated. The year 1940 was chosen as the arbitrary cutoff point for trend analysis. The communities and their incorporation dates are listed in Table 1.

The second assumption is that at the time a city is incorporated, its location may be regarded as the best means of satisfying the needs of the founding group. Therefore, in order to understand settlement trends, it is necessary to regard city locations in terms of original needs. In one case, for example, a very important need may have been a water supply for adjoining crop land, in another this may have been of less importance.

A final point of theoretical importance concerns the nature of Figure 2. Figure 2 is a trend surface map, and it is based on output generated by the SYMAP computer program. A trend surface map is a theoretical or *predicted* surface based on a least squares criterion. In this case, city locations are defined by X and Y coordinates, and the predicted dates of incorporation are defined by the Z coordinate. SYMAP reduces the sums of the squares to a minimum by using any one of several polynomial functions that delimit trend surfaces within a three-dimensional (X, Y, Z) coordinate space.

The polynomial functions describe progressively more complex trend surfaces. The first-order polynomial function describing the trend surface is a linear equation in which the surface is a plane; the second-order polynomial function is a quadratic equation where the surface is a paraboloid; and the third-order polynomial function is a cubic equation, permitting two extreme points, a peak and a pit. SYMAP also maps

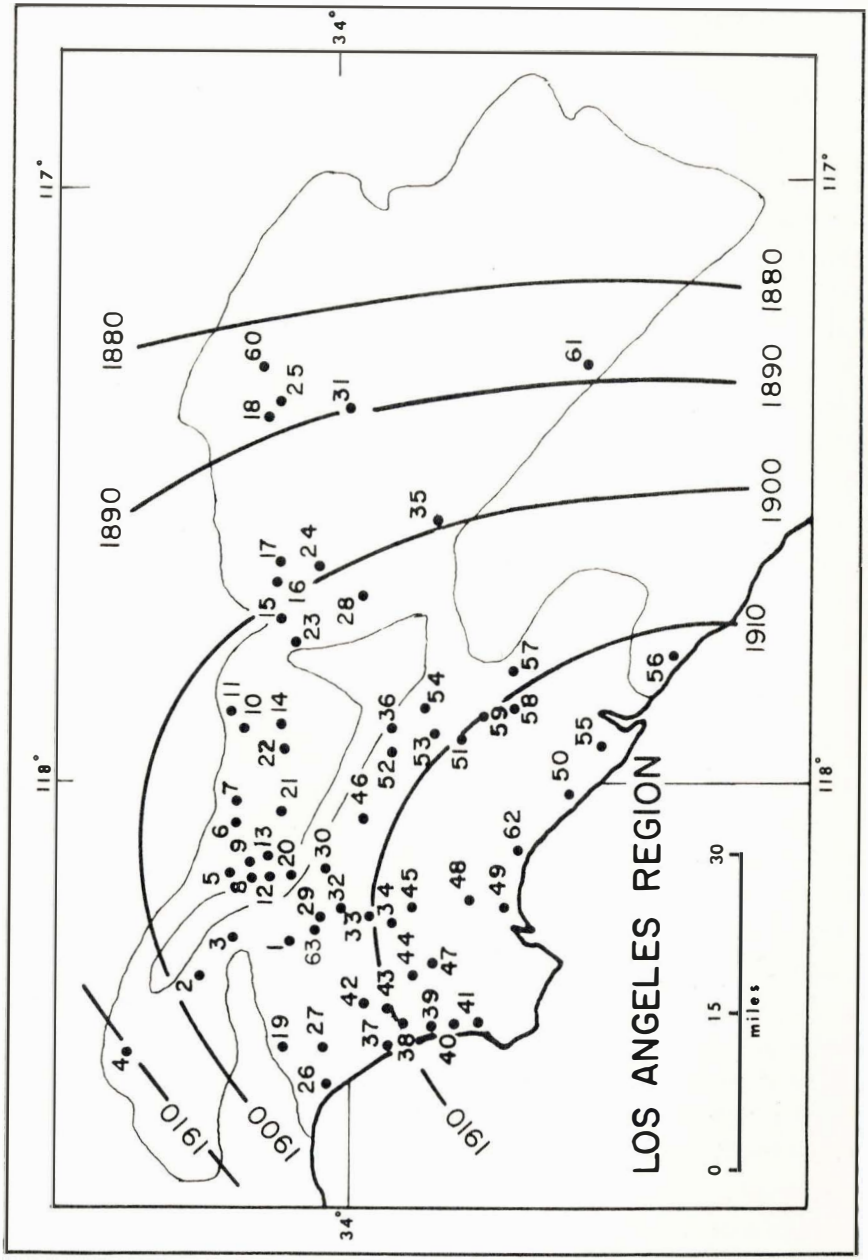

Figure 2. Trend surface map showing spread of settlement in the Los Angeles region (1850-1940). The numbers on the map correspond to the city names given in Table 1.

Table 1
City Names and Their Incorporation Dates

Map No.	Name	Date	Map No.	Name	Date
1	Los Angeles	1850	33	South Gate	1923
2	Burbank	1911	34	Lynwood	1921
3	Glendale	1906	35	Corona	1896
4	San Fernando	1911	36	Brea	1917
5	Pasadena	1886	37	El Segundo	1917
6	Arcadia	1903	38	Manhattan Beach	1912
7	Monrovia	1887	39	Hermosa Beach	1907
8	South Pasadena	1888	40	Redondo Beach	1892
9	San Marino	1913	41	Palos Verdes Est.	1939
10	Azusa	1898	42	Inglewood	1908
11	Glendora	1911	43	Hawthorne	1922
12	Alhambra	1903	44	Gardena	1930
13	San Gabriel	1913	45	Compton	1888
14	Covina	1901	46	Whittier	1898
15	La Verne	1906	47	Torrance	1921
16	Claremont	1907	48	Signal Hill	1924
17	Upland	1906	49	Long Beach	1897
18	Rialto	1911	50	Huntington Beach	1909
19	Beverly Hills	1914	51	Anaheim	1878
20	Monterey Park	1916	52	La Habra	1925
21	El Monte	1912	53	Fullerton	1904
22	West Covina	1923	54	Placentia	1926
23	Pomona	1888	55	Newport Beach	1906
24	Ontario	1891	56	Laguna Beach	1927
25	Colton	1887	57	Tustin	1927
26	Santa Monica	1886	58	Santa Ana	1886
27	Culver City	1917	59	Orange	1888
28	Chino	1910	60	San Bernardino	1869
29	Vernon	1905	61	Lake Elsinore	1888
30	Montebello	1920	62	Seal Beach	1915
31	Riverside	1883	63	Huntington Park	1906
32	Maywood	1924			

fourth-, fifth-, and sixth-order trend surfaces with additional points of inflection provided by more complex polynomial equations.[8]

The mathematical descriptions of the above trend surfaces constitute a statistical smoothing operation in which the sums of the squares are progressively reduced with higher-order surfaces. Hence, higher-order surfaces will be more accurate in their predictions and thereby reflect only local variations in Z-values. Conversely, lower-order trend surfaces are more generalized predictions; they are not complicated by local variations, and can thus be used in identifying trends over a larger area. Because Figure 2 is a low (second)-order trend surface, it is used as a basis for the student project described below.

Student Project

The student project proposed involves both an instructional and an activity phase.

Instructional Phase. The instructor must explain the purpose of the project as well as the utility and general nature of the trend surface map shown in Figure 2. In addition, the instructor must also clarify the importance of location factors in the early growth and incorporation of cities. In order to accomplish these tasks, the following scenario is recommended.

First, the instructor explains to the students that the objective of the geographic inquiry which they are about to pursue is two-fold: they will (a) learn about the importance of geographic location as a factor in the early growth and incorporation of cities, and (b) formulate hypotheses regarding the spread and timing of settlement in the Los Angeles region.[9]

The utility of Figure 2 is explained next. The instructor does this by pointing out that Figure 2 illustrates how settlement in the Los Angeles region spread from inland areas toward the coast over the nine decades between 1850 and 1940. The instructor continues by explaining some of the locational relationships within the region that may have influenced this

settlement trend. For example, during the pre-1910 years this trend reflected the Los Angeles region's importance as a center for citrus production. Most of the cities that became incorporated were located inland from the Coastal Plain where soils, temperature regimes, and water supplies on the upper portions of alluvial fans were amenable to that type of agricultural activity. In contrast, during the 1910-1940 period most cities which incorporated were located along the southern part of the Coastal Plain, reflecting this area's expanding road and railroad networks, a local oil mining boom, and the growing commercial and industrial activity associated with improvement in the region's ocean trade.

Next, since the trend surface map is the primary basis on which students' hypotheses will be made, the instructor explains that the trend in settlement depicted in Figure 2 is rather general and that there are many exceptions to the trend. A common problem is that students incorrectly assume that cities located between given isochrones were actually incorporated during the time period the lines define; thus, their hypotheses prove to be untenable. The instructor avoids this problem by noting some examples of cities listed in Table 1 whose incorporation dates do not correspond with the settlement trend depicted on the map.

This is an auspicious time for the instructor to demonstrate further the utility of the trend surface map by beginning a discussion as to why certain cities were not incorporated according to the predicted trend. This may be done by asking a series of questions that are based on examination of Figure 2. For example, "Why were Los Angeles, Anaheim, and San Bernardino incorporated earlier than expected according to their locations on the trend surface map?", "Why were coastal cities such as Redondo Beach, Hermosa Beach, and Newport Beach incorporated before the predicted 1910-1940 period?", or "If both Pasadena and San Gabriel are located in the same geographic area (the San Gabriel Valley), why was Pasadena incorporated before the predicted 1900-1910 period and San

Gabriel after this period?" Discussion of possible answers to such questions will focus further attention on the roles that locational relationships have played in the evolving urban landscape of the region.

The instructor concludes this phase of the project by providing and discussing a list of cultural and environmental factors which can contribute to a city's location and population growth. Table 2 includes a list of such factors.

Activity Phase. There are four activities involved in this phase of the student project. The taxonomy of behavioral objectives developed by Bloom, *et al,*[10] is used in the following discussion to emphasize that these activities constitute a logical sequence toward higher levels of learning. The learning level objective for each activity is first defined; then a description is given as to how the objective is to be accomplished.

(1) *Knowledge.* Knowledge is defined as the remembering of previously learned material. By the end of the instructional phase, the students should know how to interpret the trend surface map. In order to make sure that this objective has been accomplished, the instructor gives the students a list of all the cities shown in Figure 2 and asks them to indicate whether or not each city was incorporated before, after, or according to the trend. Their answers can be checked quickly in class, and any misunderstandings about how to interpret the map can be rectified at this time.

(2) *Comprehension.* Comprehension is defined as the ability to grasp the meaning of material. The instructor assigns each student a city to research. Based on this research, the student identifies location factors, from a list such as the one included in Table 2, which contributed to the location and growth of the city prior to incorporation. In order to demonstrate that the student understands the roles of these location factors, he or she ranks each one according to its importance in determining the city's location and in influencing its early growth. (In order to avoid confusion about this activity, a simple subjective ranking is recommended, such as: A—Extremely Important;

Table 2
Tabulation Worksheet

Instructions. Rank the location factors as to their importance in the formation and growth of cities prior to their incorporation dates. Place one of the following letter symbols in each of the boxes in the chart:

A—Extremely Important
B—Highly Important
C—Important
D—Not Important

Location Factors	City Identification Number (See Table 1 for city name)				
Environmental Factors	2	6	7	34	46
1. Climate					
2. Water Supply					
3. Soils					
4. Topography					
5. Scenery					
6. Hot Springs					
7. Other					
Cultural, Economic, and Political Factors					
1. Religion					
2. Social Movement					
3. Language/Race					
4. Politics					
5. Land Ownership					
6. Resort/Recreation					
7. Railroad(s)					
8. Highway(s)					
9. Pack Trail(s)					
10. Sea Port					
11. Agricultural Processing					
12. Mining/Manufacturing					
13. Centrality*					
14. Other					

*The term *centrality* refers to the tendency for city growth because the city's retail and service functions benefit from its location with respect to other population centers.

B—Highly Important; C—Important; and, D—Not Important.) A short essay and/or oral report is assigned so that the student can explain his or her selection and ranking of location factors.

(3) *Analysis.* Analysis means separating the whole into its constituent parts with a view to its examination and interpretation. The student is first asked to refer to the trend surface map in order to determine if his or her city was settled according to the settlement trend. Based on this determination, the student must then re-examine each of the location factors of importance in the city's incorporation in order to explain why the city became incorporated in the year that it did.

(4) *Synthesis.* Synthesis refers to the ability to put parts together to form a new whole. The students must analyze a chart such as the one shown in Table 2, except that this chart will be filled in with all of the cities studied by the class, including all of the location factors and their ranking for each city. The students are asked to combine information from the chart and from what they have learned from previous activities so that they can draw inferences and formulate tentative hypotheses which answer the following questions:

(a) Why were certain cities incorporated earlier than the predicted trend?

(b) Why were certain cities incorporated according to the trend?

(c) Why were certain cities incorporated later than predicted?

Upon completion of the synthesis activity, the students will discuss with the instructor and the rest of the class why they believe that their hypotheses may or may not be valid.

Summary

This paper describes how a trend surface map can be used as an instructional and analytical tool to overcome difficulty in

understanding complex locational relationships inherent in the development of the Los Angeles urban landscape. The trend surface map is used because it represents an average trend in settlement as it spread over the region.

The student project described above details how students are guided toward making deductions and formulating hypotheses about locational relationships which have influenced the timing of settlement in the Los Angeles region. In order to assure that this goal is attained, this project is structured according to behavioral objectives, each objective requiring a higher level of learning than previous ones.

The student project can serve as the basis for additional studies. Some examples include: (a) students can be assigned library research and field observation work in order to determine the validity of their hypotheses; (b) SYMAP can be used to generate a second-order residual map so that the degree to which urbanizing areas deviated from the settlement trend may be analyzed; and, (c) maps of other urban areas can be generated in order to make comparisons regarding the timing and spread of settlement in different regions of the country.

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NOTES

1. David W. Lantis, et al., *California, Land of Contrast,* (Dubuque, Iowa: Kendall/Hunt Publishing Co., 3rd Ed., 1977), pp. 79-173.
2. Rodney Steiner, *Los Angeles, The Centrifugal City* (Dubuque Iowa: Kendall/Hunt Publishing Co., 1981).
3. Homer Aschmann, "Purpose in the Southern California Landscape," *Journal of Geography,* Vol. 66 (1967), pp. 311-317.

4. Robert M. Fogelson, *The Fragmented Metropolis—Los Angeles 1850-1930* (Cambridge, Mass: Harvard University Press, 1967).
5. For a background of city formation in Los Angeles County the reader should consult, Richard Bigger and J. Kitchen, *How the Cities Grew* (Los Angeles, Calif.: Haynes Foundation, 1952). A companion work, *Metropolitan Coast* (1958) treats Orange and San Diego counties.
6. Reyner Banham, *Los Angeles, the Architecture of Four Ecologies* (New York, New York: Penguin Press, Bantam, 1971).
7. A more extensive review of the geographical literature than the one presented in this paper is found in David W. Lantis, "Bicentennial Los Angeles: Comments on the Metropolis and Pertinent Literature," *The California Geographer*, Vol. XXI (1981), pp. 67-80.
8. *SYMAP User's Reference Manual* (Cambridge, Mass.: Laboratory of Computer Graphics and Spatial Analysis, Graduate School of Design, Harvard University, 1979). Sources that discuss trend surface mapping in more detail than presented in this paper include: R. J. Chorley and P. Haggett, "Trend-Surface Mapping in Geographical Research," *Transactions and Papers of the Institute of British Geographers*, No. 37 (1965), pp. 47-67; John P. Cole and Cuchlaine A. M. King, *Quantitative Geography, Techniques and Theories in Geography* (New York, New York: John Wiley and Sons, Ltd., 1968), pp. 375-379; and, Mark S. Monmonier, *Computer Assisted Cartography, Principles and Prospects* (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1982), pp. 52-55.
9. Students must understand the nature and purpose of the hypothesis before they can complete the synthesis phase of the project. Two recommended reading assignments are: L. Lloyd Haring and John F. Lounsbury, *Introduction to Scientific Geographic Research* (Dubuque, Iowa: Wm. C. Brown Company, 3rd Ed., 1983), pp. 11-22; and, Preston E. James, *All Possible Worlds: A History of Geographical Ideas* (New York, New York: The Odyssey Press, Bobbs-Merrill Company, Inc., 1972), pp. 471-474. A more advanced reading is, James L. Newman, "The Use of the Term 'Hypothesis' in Geography," *Annals, of the Association of American Geographers*, Vol. 63 (1973), pp. 22-27.
10 B. S. Bloom, ed., et al., *Taxonomy of Educational Objectives: Cognitive Domain* (New York, New York: David McKay Company, Inc., 1956).