



---

## RESIDENTIAL TELEPHONE SERVICES

### Context

Local telephone service typically involves the choice between flat (i.e., a fixed monthly charge for unlimited calls within a specified geographical area) and measured (i.e., a reduced fixed monthly charge for a limited number of calls and additional usage charges for additional calls) services. Various flat rate services differ by the size of the geographical area within which calling is provided at no extra charge, the monthly charge being higher for larger areas. Measured services differ with respect to the threshold number (or dollar value) of calls beyond which the customer is charged. The availability of each service may depend on the geographical location within the service area.

In developing a model of the residential demand for local telephone service, it is necessary to explicitly account for the inter-relationship between class of service choice and usage patterns. For example, expected usage patterns will influence the household's choice of service option since households with high usage levels typically could minimize their monthly bill for local telephone service by choosing some sort of flat rate service, while households with relatively low usage would be better off with a measured service. Given that a household has chosen a particular service option, usage patterns would be dependent to a certain extent upon the service option that is chosen since it determines the marginal price of calls. To accommodate these interrelationships, the model representing the household's choice of calling patterns and service options needs to include:

1. choice of the service option, which is modeled conditional upon the calling portfolio chosen by the household;
2. choice of the calling portfolio or the usage pattern as represented by the number and duration of calls by time of day and calling band.

This case study deals only with the first choice.

### Data Collection

A household survey was conducted in 1984 for a telephone company among 434 households in Pennsylvania. The dataset involves choices among five calling plans and consists of various attributes and socio-economic characteristics. It was originally used to develop a model system to predict residential telephone demand.

### Variables and Descriptive Statistics

In the current application, five types of services are involved: two measured options and three flat options. The availability of these service options varies depending upon geographic location.

Table 1 below lists the five service alternatives and their availability within the different service areas. Names and definitions of the variables are shown in Table 2. Some descriptive statistics of the dataset are summarized in Table 3.

**Complications caused by very few respondents choosing alternative 4:** If you examine the dataset, you see that only 3 of the respondents chose alternative 4 (extended area flat service). This implies that it is not possible to estimate numerous alternative specific coefficients for alternative 4. The intuition is that the dataset does not provide enough information on why people chose or did not choose alternative 4. If you try to estimate too many alternative specific coefficients for alternative 4, you get "Singularity in the Hessian" error, and in order to estimate the model you have to reduce the number of coefficients specific to alternative 4. A practical solution to this problem is to use an "enriched sample" although such a sample is not available here. It is however not recommended to omit the observations for which the chosen alternative is 4 or combine alternative 4 with a different alternative.

Service option	Description	Availability		
		metro, suburban, some perimeter areas	other perimeter areas	non-metro areas
1. Budget measured	No fixed monthly charge; usage charges apply to each call made.	yes	yes	yes
2. Standard measured	A fixed monthly charge covers up to a specified dollar amount (greater than the fixed charge) of local calling, after which usage charges apply to each call made.	yes	yes	yes
3. Local flat	A greater monthly charge that may depend upon residential location; unlimited free calling within local calling area; usage charges apply to calls made outside local calling area.	yes	yes	yes
4. Extended area flat	A further increase in the fixed monthly charge to permit unlimited free calling within an extended area.	no	yes	no
5. Metro area flat	The greatest fixed monthly charge that permits unlimited free calling within the entire metropolitan area.	yes	yes	no

Table 1: Service options and their availability

Name	Description
age0	number of household members under age 6
age1	number of household members age 6-12
age2	number of household members age 13-19
age3	number of household members age 20-29
age4	number of household members age 30-39
age5	number of household members age 40-54
age6	number of household members age 55-64
age7	number of household members 65 and older
area	location of household residence 1=metro, 2=suburban, 3=perimeter with extended, 4=perimeter without extended, 5=non-metro
avail1, avail2, avail3, avail4, avail5	binary indicators of availability of each option. availX=0 if alternative X is not available to the household, availX=1 if alternative X is available to the household
choice	chosen alternative (dependent variable) 1=budget measured, 2=standard measured, 3=local flat, 4=extended flat, 5=metro flat
cost1, cost2, cost3, cost4, cost5	costX = monthly cost (in \$) of alternative X.
employ	number of household members employed
inc	annual household income 1=under \$10,000, 2=\$10,000-20,000, 3=\$20,000-30,000, 4=\$30,000-40,000, 5=over \$40,000
ones	ones = 1 for all observations
status	marital status 1=single, 2=married, 3=widowed, 4=divorced, 5=other
users	number of phone users in household

Table 2: Description of variables

	mean	max	min	stand dev	range
age0	0.21	4	0	0.53	4
age1	0.23	3	0	0.58	3
age2	0.24	4	0	0.67	4
age3	0.41	3	0	0.71	3
age4	0.44	2	0	0.73	2
age5	0.36	2	0	0.67	2
age6	0.31	3	0	0.61	3
age7	0.38	2	0	0.65	2
area	2.93	5	1	1.65	4
avail1	1.00	1	1	0.00	0
avail2	1.00	1	1	0.00	0
avail3	1.00	1	1	0.00	0
avail4	0.03	1	0	0.17	1
avail5	0.65	1	0	0.48	1
choice	2.65	5	1	1.17	4
cost1	11.73	433.5	3.28	24.13	430.22
cost2	11.49	432.8	5.78	23.90	427.02
cost3	14.82	435.5	7.03	23.56	428.47
cost4	62.19	433.03	10.48	117.88	422.55
cost5	27.48	38.28	23.28	4.17	15
employ	1.07	3	0	0.89	3
inc	2.53	5	1	1.28	4
ones	1.00	1	1	0.00	0
status	2.22	5	1	0.91	4
users	2.30	6	1	1.28	5

Table 3: Descriptive Statistics