Our analysis distinguishes small and large cable systems in terms of:

Economic Factors

- *Income level* in the community, which is associated with ability of subscribers to pay for cable, and with local staff compensation
- *Local TV stations,* which represent a competitive substitute for cable
- *Number of satellite channels*, which affects operating expenses as well as providing means for competitive differentiation apart from price

and ***Technology Factors***

- *Addressability*, which involves higher capital investment as well as enhanced opportunities for revenues from premium services
- *Channel capacity*, which involves higher capital investment and allows for non-price competitive differentiation
- *Household density*, which is associated with plant investment per subscriber

Tables III-4 and III-5 list some of the economic and technology variables that individually, and then jointly, differentiate cable systems by size at a high level of statistical significance.

The following is an illustrative example of the predictive technique, using variables which jointly predict the size of systems in the competitive sample:

Attribute	**Huntsville** (AL0012)	**Troy** (AL0127)
Income	$31,900	$17,365
Total channels	40	44
MSO Ownership	Yes	Yes
Density (HP/Mi)	87.7	44.8
Calculate Index-->	+5.3	-3.0
Likelihood Franchise is Large----------->	0.996	0.05

This technique leads to creation of a classification table that demonstrates our ability to predict the size of a very high proportion of the cable systems which operate franchises in the FCC's competitive and non-competitive samples.

Competitive		**Predicted**	
	Actual	Large	Small
	Large	*17*	4
	Small	5	*24*

Non-Competitive		**Predicted**	
	Actual	Large	Small
	Large	*136*	27
	Small	29	*174*

Thus we are able to demonstrate the following:

- Small systems are different from large ones
- The difference can be expressed in economic and technology terms

While certain variables in this procedure suggest that small systems have lower investment (e.g., small capacity systems) and operating expenses (e.g., market income, which relates to local salary scales), there are other variables which provide contrary indications. For example, higher density and penetration, which are typical of larger systems, tend to be associated with lower per-subscriber investment.

Table III-4. Individual Predictors of System Size

System Size as Predicted by Economic & Technology Factors (FCC Sample)			
System Attributes	**Variables**	**Competitive N=50**	**Non-Competitive N=370**
Market		**System Size:**	**System Size:**
HIGHER median income	INCOME	Large	Large
MORE local TV stations	S7_1/2/3LTV	Large	Large
Plant		**System Size:**	**System Size:**
HIGHER % addressable subs	S2_ASUB/HHSUB	Not Significant	Large
MORE activated channels	S7_TOTAC	Large	Large
MORE homes passed/mile	S2_HHPAS/MILES	Large	Large
Operating Expenses		**System Size:**	**System Size:**
MORE Satellite Channels	S7_1/2/3STV	Not Significant	Large

Table III-5. Joint Predictors of System Size

Best Joint Predictors of Cable System Size		
Sample	**Attribute**	**Variable Name**
Competitive N=50	Market Income Level Total Channels Ownership by MSO Density (HP/Mi)	INCOME S7_TOTAC S2_PARTM S2_HHPAS/MILES
Non-Competitive N-370	Market Income Level Ownership by MSO Total Channels Density (HP/Mi) Penetration (Subs/HP)	INCOME S2_PARTM S7_TOTAC S2_HHPAS/MILES S2_HHSUBS/HHPAS
Competitive Without Municipals N-39	Addressability (%Subs) Ownershp by MSO Local TV Stations	S5_ADDRS/HHSUBS S2_PARTM S7_1/2/3LTV

5. Small Systems Have Lower Costs

Our primary research provides additional information on investment and operating expenses, to supplement the FCC's database[12]. Our results indicate that small systems tend to have lower costs, which in turn allow for lower revenue requirements.

(The small systems also tend to exhibit poorer financial performance, suggesting that even with lower revenue requirements, their rates are inadequate. We discuss this finding in detail in Section IV.)

Based on data from the Arthur D. Little interviews, Table III-6 shows substantial differences between the small and large systems in:

- ratio of franchise subscribers to overall system subscribers, a factor related to ability to subsidize franchise operations from a larger system base
- average monthly rates for basic services (excluding charges for equipment)
- rate increases since the FCC's 9/92 survey.

[12]Contacts were made with operators of all 50 "competitive" franchises. Financial data were obtained for 37 of the franchises. System data, not including financials, were obtained for 6 additional franchises. Operators of 7 of the franchises declined to participate in the survey.

Table III-6. Average Size and Rates Charged

	Small Cable Systems	Large Cable Systems
Average Subscribers		
• Franchise	1117	5044
• System	1990	42543
Ratio Franchise:System	1:1.8	1:8.4
Average Monthly Rates		
• Basic services	$14.77	$22.33
• Increase since 9/92	$ 0.23	$ 1.94

In Table III-7, we summarize differences in economic and technology factors.

Table III-7. Large Versus Small Systems on Technology and Economics

	System Size		Difference	
Technology & Economic Factors	Small	Large	Number	% of Large
Capital Expenditure				
• Per Mile	$17,983	$21,433	$3,449*	16%
• Per Sub	$679	$670	($9)	(1%)
• Per Sub (Weighted by age of plant)	$292	$344	$52	15%
Age of Plant (Years since construction)	8	5	(3)	(58%)
Satellite Networks Carried	28	34	6	17%
Addressable Subscribers (% Basic)	10%	41%	31%	75%
Active Channels	40	54	15*	27%
Churn	15%	24%	9%	39%
Subscribers/Employee	524	547	23	4%

* Rounding error

These data show that small systems differ from large systems in terms of:

- ***Capital Expenditure***
  Lower per mile of plant. Approximately equal per subscriber, due to lower density. Lower per subscriber when *weighted* by the number of years since the investment was made.

- ***Age of Plant***
  More years since original construction or most recent major rebuild.

- ***Satellite Networks***
  Fewer, i.e., less service, lower operating cost

- ***Addressability***
  Lower proportion of subscribers with addressable equipment, i.e., lower capital investment

- ***Total Channel Capacity***
  Less, i.e., lower capital investment, less ability to exploit expanded or premium service opportunities

- ***Churn***
  Less, i.e., lower operating cost

These differences reach statistical significance for addressability, channel capacity and age of plant. They approach, but do not quite reach significance at the $P<.10$ level, for satellite networks and churn. However, the apparent differences in capital expenditure as summarized in Table III-7 do not reach statistical significance. This may provide a partial explanation of financial performance results described in Section IV.

Another variable, subscribers per employee (a measure of management efficiency), does not appear to differentiate small and large systems. Large systems have an average of 4 percent more subscribers per employee (547 vs. 524). This may reflect their ability to exploit economies of scale which balances the greater demands on management that are typical of larger systems.

IV. Financial Viability of Competitive Franchises

In our survey, we ask for data on annual revenues, operating expenses, and operating cash flow (revenues minus expenses, before depreciation, debt service and taxes). We also ask for data on capital investment at the time of original construction or of the most recent significant rebuild.

Financial performance is critical because the average revenues of the competitive franchises, and in particular, of the small competitive franchises, are establishing rate benchmarks for the entire industry. If these franchises are commercially non-viable, it is unreasonable to direct the industry to emulate their financial performance through imposition of benchmarks influenced by their rates.

A. Differences Between Small and Large Systems

The survey reveals significant financial differences between the franchises that are part of small and large systems. Our data show small systems in the sample are performing relatively poorly, as summarized in Table IV-1.

Table IV-1. Financial Performance of Small Versus Large Systems

	System Size		Difference	
Financial Performance	Small	Large	Number	% of Large
Average Revenues				
• Total per subscriber per year	$253	$376	$123	33%
• Regulated services	$200	$265	$65	25%
Average Operating Expenses	$178	$223	$44*	20%
Average Cash Flow Margin	27%	40%	13%	32%

* Rounding error

Operating expenses for small-system franchises are, on average, 20 percent lower than expenses of large systems[13]. However, their cash flow margin, which is a key cable TV financial measure, is also on average much lower (by 32 percent)[14]. These differences are highly significant statistically.

[13]Small-system franchises' operating expenses per subscriber may be lower as the net result of several factors: lower cost of managing in small markets and of operating less sophisticated plant, less premium programming, but also (pushing towards higher per-subscriber expenses) less ability to exploit economies of scale in staffing.

[14]Included in Table IV-1 is one small-system franchise that reports negative cash flow; when this extreme case is excluded, the average cash flow margin of the small-system franchises is 31%.

Several explanations for this finding are plausible:

- Small systems have less channel capacity for premium services and tend to serve markets in which premium services gain lower penetrations relative to basic. Premium services generate higher margins overall than basic services because they produce higher revenues per unit of utilized plant, despite higher expenses on a per-channel basis for premium programming.

- Because they cannot as readily differentiate on service features, smaller systems that are providers of commodity cable channels may be more subject to price competition. Their rates may be governed by competitive pressures without regard, at least in the short term, to their cost of providing service.

- Franchises that are part of small systems lack comparable access to intra-system subsidies, unlike franchises which may represent only a minor portion of the activities of larger systems.

For these and possibly other reasons, many of the small-system franchises in the FCC's competitive sample are not collecting sufficient revenues, even given lower operating expenses, to provide an adequate return on their capital investment.

B. Commercial Viability of Franchises

Average cash flow margins[15] generated by the large systems in the competitive sample, at approximately 40%, are similar to those typically reported in the cable industry. Cash flow margins of large MSOs which serve most industry subscribers are typically 40 percent and higher, as reported in Cablevision (23 May 1994, p. 102) for MSOs among the 50 largest which have provided financial data:

	Cash Flow Margin
Tele-Communications Inc.	44.7%
Time Warner Cable	46.9%
Comcast Cable Communications	45.3%
Continental Cablevision	43.9%
Cablevision Systems	37.8%
Jones Intercable	44.2%
Cablevision Industries	48.8%
Adelphia Communications	56.8%
Viacom International	43.7%
Falcon Cable TV	64.7%

[15]Cash flow margin is operating cash flow (revenues minus operating expenses), as a proportion of revenues. Another cable industry term for operating cash flow is "cable cash flow."

	Cash Flow Margin
Century Communications	58.5%
Scripps-Howard Cable	40.2%
KBLCOM	39.2%
TCA Cable TV	51.0%
Multimedia Cablevision	51.9%
TKR Cable	49.5%
Columbia International	47.2%
Summit Cable Services	61.0%

By comparison, the average cash flow margins of the small-system franchises are much lower, at 27 percent.

Our survey data indicate that 10 franchises produce cash flow margins at 25 percent or lower; all of these are small-system franchises. Another 7 produce cash flow margins between 25-30 percent, still well below industry norms. In the latter group, 3 are small-system franchises. Thus, small-system franchises account for 13 of 17 in the competitive sample, for which we have data, that generate below-norm returns.

A full listing of financial measures for all franchises providing these data is provided in Appendix 3. Identities of the franchises are re-coded to protect their proprietary financial information.

1. Financial Model Tests Commercial Viability

To test the commercial viability of the franchises reporting below-norm cash flow margins, we employ a simple financial model which measures the pre-tax equity rate of return produced by these cash flows, given the amount of equity investment in the franchise.

Key financial assumptions for the model are based upon guidelines provided by the FCC in its "1994 Cost of Service" Report and Order:

- Interest rate: 8.5%
- Debt leverage 50%
- Overall rate of return 11.25%
- After-tax return to equity 14% (Derived using FCC formula)
- Allowed additional return for tax[16] 7.21% (Derived using FCC formula)

These assumptions define a pre-tax equity rate of return of 21.21 percent (i.e., 14 percent plus 7.21 percent).

[16]We use the 34% federal corporate tax rate as assumed by the FCC. The current corporate tax rate, now 35%, would increase the "allowed additional return for tax" and thus the target pre-tax equity rate of return We also do not take into account state taxes.

Where the FCC has not provided guidance, we use assumptions that are conservative in the sense that they will not underestimate financial returns and that mirror common practice in the industry:

• Debt repayment		
- Term (Years)	9	No factor for small operators
- Start date (Year)	3	
• Terminal multiple of Cash Flow	9	No factor for overbuild competition
• Real annual cash flow growth	1%	Growth despite no added investment
• Mature cash flow level (Year)	1	No start-up period after capital investment
• Annual capital investment	$0	No factor for plant upgrade and converter replacement

Of the franchises that we surveyed, there are 11 that provide all relevant financial information including data on capital investment[17], and that report cash flow margins of 35 percent or less.

Model runs, which are attached in Appendix 3 and summarized in Table IV-2, confirm that these franchises, except for one (QQ147 with 34 percent cash flow margin) provide returns to equity investors that fail to achieve the 21 percent pre-tax equity IRR target.

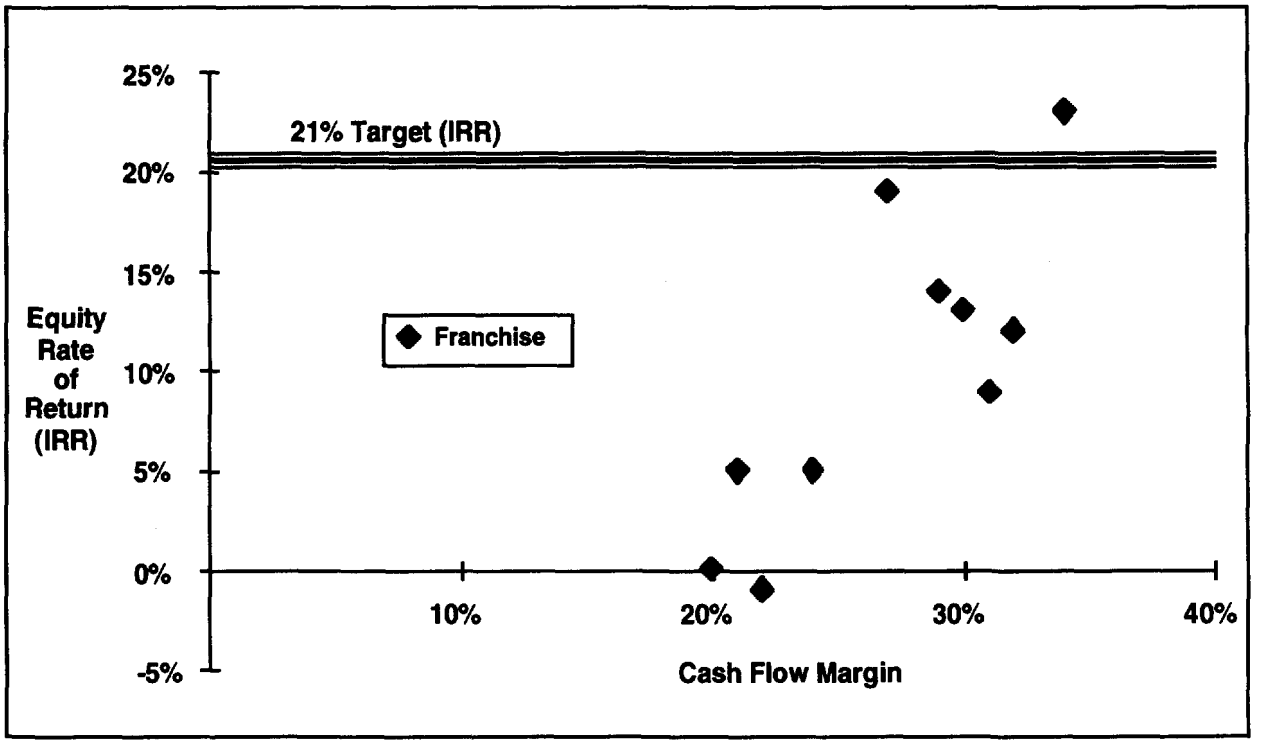
Table IV-2. Internal Rates of Return versus Cash Flow Margins

Franchise	Cash Flow Margin	Equity IRR
QQ111	20%	0%
QQ150	21%	5%
QQ159	22%	-1%
QQ115	24%	5%
QQ140	24%	9%
QQ145	27%	19%
QQ146	27%	19%
QQ134	29%	14%
QQ151	30%	13%
QQ135	32%	12%
QQ147	34%	23%

[17] In some cases, capital investment information was unavailable because of the passage of time or change of ownership. Where available, we use most recent rebuild investment rather than original capital investment; this reflects the most current investment levels for cable plant but is conservative because rebuilds seldom involve complete plant replacement, e.g., of strand, headend equipment, or CPE, and thus tend to understate total investment in the system

Chart IV-1 illustrates the same finding. With their low returns, some of these franchises are unlikely to survive over the long term and the others will face continuous difficulties obtaining funds for reinvestment.

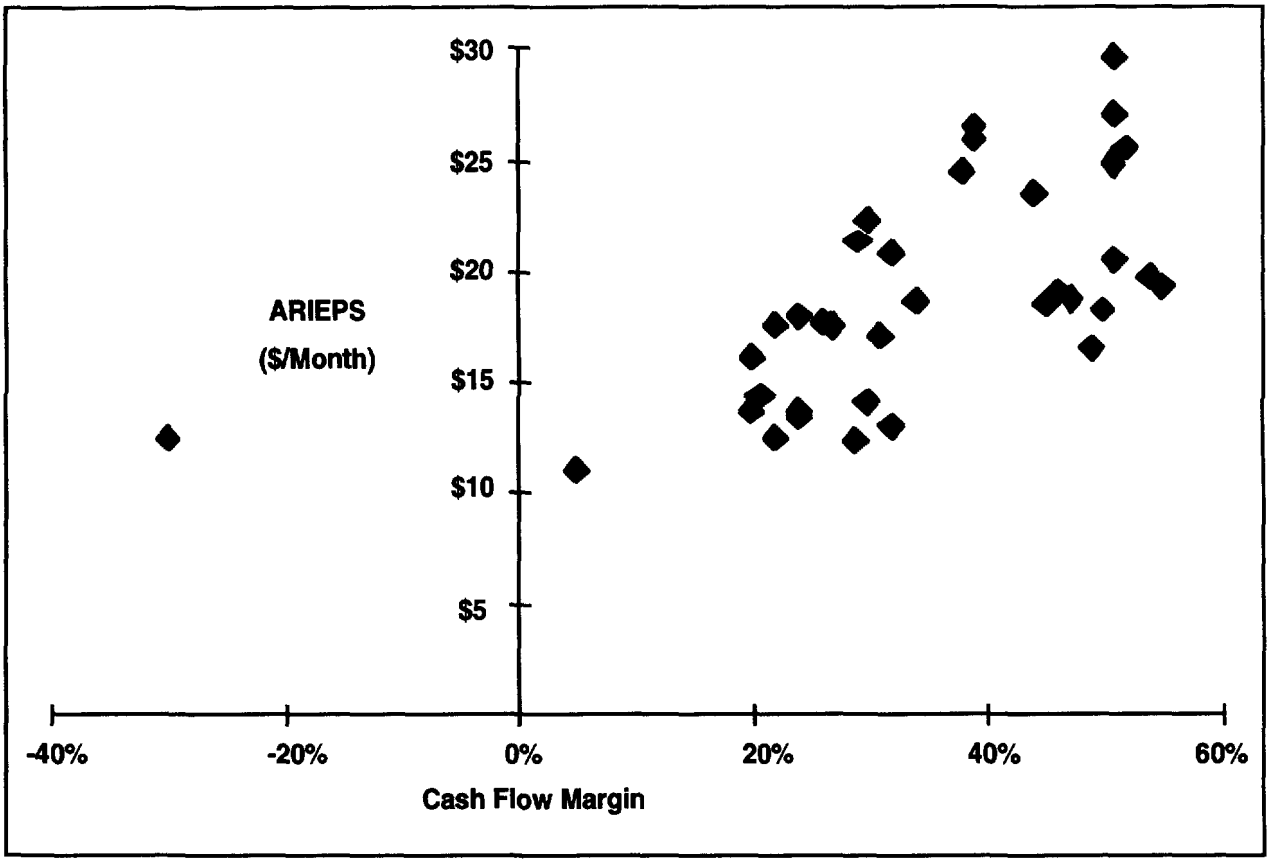
Chart IV-1 Rate of Return for Franchises with Low Cash Flow Margins



Franchises that are commercially non-viable or financially constrained from reinvestment should not be included in a sample that is used to establish benchmarks for the entire cable industry.

Our survey does not provide sufficient financial data to calculate cash flow margins for all franchises in the sample. Financial performance may be inferred, however, from the FCC's ARIEPS variable. As depicted in Chart IV-2, franchise cash flow margin and ARIEPS are related; our correlation analysis indicates a .63 level of correlation. This is not a surprising result. However, it suggests that detection of very low ARIEPS scores should be followed by additional research on the franchise's financial condition, and that it is likely to be inappropriate to allow such franchises to influence calculations of rate benchmarks for the cable industry.

Chart IV-2 Relationship Between ARIEPS and Cash Flow Margin



V. Other Issues Concerning FCC Competitive Sample

Our survey raises additional questions concerning certain franchises in the competitive sample.

A. Erroneous Designation as Competitive

Two franchises (MD0009-W, MD0009-D) are erroneously classified as competitive, with 100 percent OVL, due to an error by the cable operator in consultation with FCC staff in completing the FCC's questionnaire. In fact, the management of these franchises now report no overbuild competition.

B. Instability in Overbuild Markets

Cable industry participants often observe that U.S. cable overbuilds tend to be temporary, usually ending in merger of the competitors, market exit by one of them, or acquisition of both by a third party.

Such instability is evident since the FCC's 9/1992 survey date in several markets served by competitive franchises:

- **MN0049 and MN0802**
  Both competitors in the same market were acquired by a third entity, the local telephone cooperative, in 1993. Price per subscriber is reported at $930 (MN0049) and $987 (MN0802), substantially lower than amounts currently paid for cable subscribers in non-competitive markets

- **FL0679**
  Competitors merged in 10/92, just after the date of the FCC survey (9/92).

- **KY0867**
  Sold in 5/1994 for $377 per subscriber, substantially lower than prices being paid for systems in non-overbuild markets.

Each of these events suggests that these franchises were not providing adequate financial performance. For three of these four franchises, financial data are lacking that would directly show their viability; the one franchise for which financial data are available reports a cash flow margin under 30 percent.

C. Evidence of Financial Non-Viability

Information obtained in the course of our survey also reveals special circumstances that call into question the inclusion of other franchises in a sample used to establish rate benchmarks for the cable industry:

- **MN0891**
  Construction was financed by a municipal General Obligation bond. Repayment in 1993 includes $46,000 from the City general fund, plus $20,000 from the cable operator.

- **MN0839**
  Debt capital was borrowed from the municipal utility. Repayment without interest is being made from cable cash flow if and when available.

- **MN0182**
  Competitive losses result in a current base of 28 subscribers. Operated by manager as only one among 65 franchises.

- **MN0115**
  Franchise is neglected and poorly maintained. Down to 58 subscribers. Owner is absent. Contractual dispute blocks sale.

- **AR0576**
  Without "other non-operating income," franchise lacks cash flow to cover "interest and miscellaneous" non-operating expenses. Competitor reports that property tax has been levied to assist repayment of General Obligation bond that financed system.

- **GA0757**
  Major shareholder is covering debt repayment with personal loans to system, which generates inadequate income to repay bank

- **OR0146**
  Most subscribers lost to competitor; now down to 75. No major upgrade for 15 years, nor rebuild for 26 years

- **XX0022**
  No return for owners. Cash sufficient only for $300/week salary of partner/manager.

- **AR0026**
  Cable operator states cash flow margin is zero, due to need to compete with municipally-owned system.

These franchises' circumstances are highly atypical of commercially viable cable systems serving most subscribers in the industry. However, the methodology used by the FCC does use data from these franchises to derive the benchmarks for cable industry rates. In this respect, in addition to other shortcomings described above, the FCC's methodology fails to provide valid support for the Commission's rate guidelines.

Appendices

Appendix 1
Statistical Analysis of FCC Database

Appendix 1: Statistical Analysis of FCC Database

Our analytical effort focused on identifying rate-related attributes that differentiate large and small cable TV systems. In this appendix we describe the statistical methods that were used to ascertain key differences between large and small systems. Unless otherwise noted, size is based on the number of subscribers served by the system; the franchise is defined as *small* if the system in which it operates serves less than 5,000 subscribers, while it is considered *large* if the system serves more than 5,000 subscribers.

In the discussion that follows, the results, conclusions, and inferences are limited to the 420 franchises considered by the FCC in establishing their competitive benchmarks. There are severe shortcomings in the database itself, which we have purposefully ignored in carrying out our assignment. These shortcomings include the following:

- *Inherent bias* in the sample; bias can be introduced at each step in which the sample is modified, filtered, or deviates in any way from the original design or intended purpose. In Appendix C - Technical Appendix, the FCC depicts extraordinary departures from the original sample design which includes a 1% random sample augmented by three additional targeted strata. The complex manipulation of sample respondents prohibits the estimation of sampling error (that is, precision), and it is unclear how the sample data could be weighted (if at all) to calculate any estimate whatsoever (e.g., total cable subscribers) that can be reliably projected to the population of all franchises and/or cable systems.

- In evaluating the accuracy of a survey, two sources of error occur; namely,

  (i) *sampling error*, which accounts for the variation inherent in selecting a valid probability sample; and

  (ii) *Non-sampling error*, which includes the effect of (among other things) non-respondents, incomplete and inadmissible responses, and data errors and omissions of all kind.

The latter is not only difficult to quantify, it is also generally more serious. In the highly acclaimed brochure "What Is a Survey?" published by the American Statistical Association (1980), the authors elicit practical guidelines for conducting a survey. In the discussion on non-sampling errors, they state the following:

> "By examining the procedures and operations of a specific survey, experienced survey statisticians will frequently be able to assess its quality. . . . In most cases, the analyst can only state that, for example, the errors are probably relatively small and will not affect most conclusions drawn from the survey, or that the errors may be fairly large and inferences are to be made with caution."

In light of the procedures used by the FCC in creating the analytical data base, it is highly unlikely that an experienced survey statistician would be willing to estimate rate structures based on this sample of 420 franchises.

Although these concerns are critical in the sense that biased samples tend to yield biased results, we have restricted our analysis to the same database used by the FCC in order to illustrate fundamental concepts in statistical analysis and data interpretation that are vital to the rate-setting process.

This appendix is structured according to the following topics:

1. Analytical objectives of our assignment;

2. Identification of relevant rate-related factors, including summary tabulations and descriptive statistics;

3. Analytical methods; namely

   - Logistic regression (discriminant analysis)
   - Cluster analysis
   - Analysis of variance (ANOVA)

4. Regression diagnostics and robustness issues encountered in the FCC analysis.

Each of these topics is discussed in detail in the remainder of this appendix.

1. Analytical Objectives

The primary objective was to identify key technology and/or economic factors that were substantially different between large and small systems. As indicated in Table 1, the FCC database clearly revealed a significant competitive price differential for small cable systems, but the difference was negligible for franchises operated by larger systems.

Table 1. Average Revenue (ARIEPS) for 420 Sample Franchises

	Small		Large	
Environment	**No. of Franchises**	**Average Revenue**	**No. of Franchises**	**Average Revenue**
Non-competitive	207	$21.09	163	$22.58
Competitive	29	$15.39	21	$22.12

Although the FCC regression model purports to relate the variability in ARIEPS to several explanatory characteristics, one of which (OVL) is a surrogate for a competitive environment, the model does not explicitly account for the interactive effect suggested in Table 1. Furthermore, the lower average revenue corresponding to the 29 small competitive franchises could possibly be attributed to several other factors associated with operating a cable TV system. In particular, we hypothesized that differences in revenue were likely to be explained by various cost and investment factors, both individually and in combination, that were neither included, nor considered as candidates, in the FCC regression model.

If we could objectively establish significant differences in economic factors associated with operating large and small systems, then the difference observed in the ARIEPS term given in Table 1 could have a more plausible explanation. Consequently, the primary objective was to identify economic-related characteristics that were effective discriminators in operating large and small cable systems.

As a secondary objective, we examined the sensitivity or "robustness" of the FCC regression analysis. Since the FCC model is intended for use as a benchmark, it is critical that predicted revenues are not unduly influenced by a small number of statistical outliers present in the database. It is well-known that estimated coefficients and predicted values (e.g., average revenue) based on regression analysis can be very misleading and unreliable in the presence of outliers. Consequently, we have also investigated the relative effects of influential observations in the FCC database.

2. Identification of Relevant Factors

We focused on characteristics measured in the FCC survey that captured elements of the investment and cost structure associated with operating a cable TV business entity. As a result, the factors listed in Section 3.1 of the report were selected as candidates for our analysis.

We then generated summary tables and various descriptive statistics for each factor in the list. An illustrative example is given in Table 2 for the factor S7_TSAT, which measures the total number of satellite-delivered cable channels at the franchise level. Since we are primarily interested in differences associated with franchise size and competitive environments, the tables were structured accordingly. A complete list of similar output for all factors is given in Volume 2, Output of Statistical Analyses. These tables were useful in displaying the underlying structure of the data, such as frequency distributions, extreme values, and other statistical properties of interest when performing exploratory data analysis. This step, for example, aids in the detection of statistical outliers and data errors, if present.

Table 2. Summary Statistics (Illustrative Example)

NCTA - Analysis of Survey Results
Tabulation of s7_tsat by size and compet. type

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S7_TSAT	System Size											
	Small				Large				Total			
	N	Average	Std. Dev	Sum	N	Average	Std. Dev	Sum	N	Average	Std. Dev	Sum
Competition Type												
Non-Competitive	207	13.51	6.92	2797.00	163	22.99	5.74	3747.00	370	17.69	7.96	6544.00
Competitive	29	22.76	6.75	660.00	21	25.86	5.96	543.00	50	24.06	6.55	1203.00
Total	236	14.65	7.52	3457.00	184	23.32	5.82	4290.00	420	18.45	8.07	7747.00

NCTA - Analysis of Survey Results
Univariates for s7_tsat - Overall

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Univariate Procedure

Variable=S7_TSAT

Moments

N	420	Sum Wgts	420
Mean	18.44524	Sum	7747
Std Dev	8.068581	Variance	65.10201
Skewness	0.246784	Kurtosis	0.238888
USS	170173	CSS	27277.74
CV	43.74344	Std Mean	0.393706
T:Mean=0	46.85023	Prob>|T|	0.0001
Num ~= 0	416	Num > 0	416
M(Sign)	208	Prob>|M|	0.0001
Sgn Rank	43368	Prob>|S|	0.0001
W:Normal	0.98101	Prob<W	0.1658

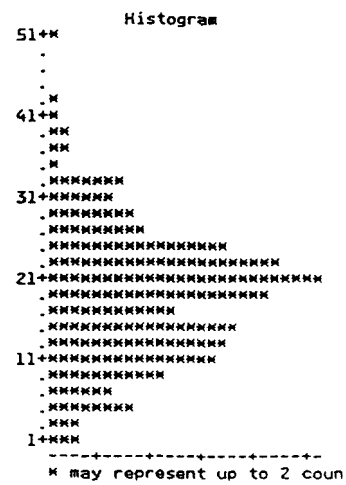
Quantiles(Def=5)

100% Max	50	99%	39
75% Q3	23	95%	32
50% Med	19	90%	28
25% Q1	13	10%	8
0% Min	0	5%	5
		1%	1
Range	50		
Q3-Q1	10		
Mode	20		

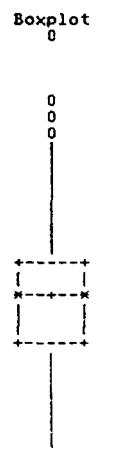
Extremes

Lowest	Obs	Highest	Obs
0(	398)	39(	51)
0(	334)	39(	214)
0(	134)	40(	75)
0(	131)	42(	11)
1(	382)	50(	86)

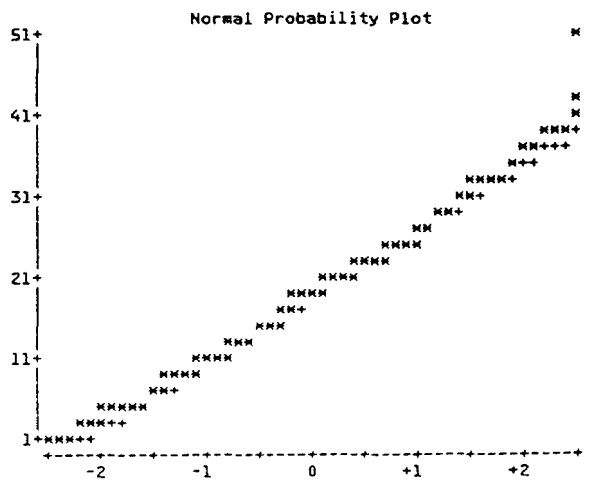
Histogram



Boxplot



Normal Probability Plot



Arthur D Little

3. Analytical Methods

3.1 Logistic Regression

Each franchise is characterized by a vector of numerous cost- and investment-related variables. We then identified variables that differ dramatically between large and small systems. Due to the dichotomous nature of the outcome variable (i.e., small or large), we used a technique known as logistic regression to examine relationships between system size and the candidate variables.

In particular, we used a step-wise technique described in an article by Efron and Gong appearing in *The American Statistician*, Feb. 1983. With this procedure, each variable is considered independently, and is tested to see if it differs (on average) between the two groups. If not, it is ignored in subsequent steps since it has no real discriminatory capability. Separate analyses were conducted within the subset of 370 noncompetitive franchises and the complementary subset of 50 competitive franchises.

Again, using total satellite channels to illustrate the concept, key results are displayed in Table 3 and are interpreted as follows.

Table 3. Logistic Regression Output

	Estimate	Standard Error (S.E.)	Weight of Evidence
Non-Competitive Sample	0.248	0.027	<0.001
Competitive Sample	0.078	0.048	0.104

If the estimate is not significantly different from zero, the characteristic has no real discriminatory capability. Significance, or weight-of-evidence as given in the table, is usually established with a level less than 0.05, or sometimes 0.10. In any event, it is evident that the number of satellite channels differs between large and small systems to a greater extent for franchises in the non-competitive subset than their counterparts in the competitive subset. This finding is consistent with the data given previously in Table 2, and supports the contention (not surprisingly in this example) that franchises in large systems have more satellite channels than those in small systems.

Interpretations similar to the foregoing were formulated for each factor.

The first step served as a screening mechanism to eliminate factors from further consideration. The next step involved the combination of factors, known to be good discriminators, into a model that would improve discriminatory capability of the cost and investment characteristics overall.

The preferred technique is sequential in the sense that variables are entered one at a time as long as the model is substantially improved. Only the final model will be presented here; its application is illustrated in Table 4 using data for two franchises in the competitive sample, both located in Alabama.

Table 4. Logistic Regression

(Illustrative Example)

Attribute	Estimated Coefficient	Huntsville (AL0012)	Troy (AL0127)
Subscribers		36,948	3,094
Model Variables			
• Income	0.00031	$31,900	$17,365
• Total Channels	0.222	40	44
• MSO Owner	3.679	1 (Yes)	1 (Yes)
• Density(HP/Mi)	0.110	87.7	44.8
• Intercept Term	-26.69		
Size Index[a]		+5.45	-2.90
Likelihood franchise is large[b]		0.996	0.05

[a]Index = -26.69 + 0.00031 (Income) + --- + 0.110 (Density)
[b]Likelihood = $e^{Index}/(1 + e^{Index})$

Based on the four economic attributes listed in Table 4, a "Size Index" is calculated, and then converted to a probability (or likelihood) that the franchise actually belongs to a large cable system. In the illustrative example, both franchises are correctly classified; however, this is not always the case. In fact, the model (in Table 4) resulted in the following classification table for all 50 competitive franchises:

Competitive Subset Classified by Model as:

Actual Size	Large	Small	Total
Large	*17*	4	21
Small	5	*24*	29

It is often informative to examine the misclassified observations in greater detail to understand the underlying "cause." For example, the 4 misclassified large franchises that have economic attributes more closely associated with small counterparts were the following:

Franchise	Income	Total Channels	MSO Owned	Density
FL 0679	$19,415	41	Yes	61.4
MD 0009	$26,084	45	Yes	46.1
MI 0011	$25,646	36	Yes	63.2
PA 0552	$21,424	56	No	49.0

Generally, these franchises are located in relatively low median income areas, offer fewer channels, and exhibit lower density (homes passed per mile) than most large systems, as illustrated by the following averages for the two size categories:

Size	Income	Total Channels	MSO Owned	Density
Large	$32,200	47	90% Yes	90.8
Small	$21,300	39	48% Yes	52.1

The five small franchises that were misclassified have the following attributes which in aggregate are more commonly associated with larger systems:

Franchise	Income	Total Channels	MSO Owned	Density
AL 0380	$17,365	66	No	57.5
AR 0026	$20,249	52	Yes	55.7
IL 0883	$31,007	36	Yes	50.9
IN 0531	$28,460	40	Yes	50.7
KY 0867	$34,125	42	Yes	26.1

It should be noted that the telephone survey conducted as part of this study subsequently revealed that KY 0867 is actually a large system. Nevertheless, the model is seen to classify 41 of the competitive 50 franchises in the "correct" size category.

A similar analysis was conducted separately for the 370 non-competitive franchises. Once again, the model was very effective in identifying factors (both individually and jointly) that were significantly different between large and small systems. The classification table given below shows that nearly 85% of the franchises are correctly classified; four observations were deleted due to missing values.

Non-Competitive Subset
Classified by Model as:

Actual Size	Large	Small	Total
Large	136	27	163
Small	29	174	203

The economic-related factors that collectively provided the best discrimination for the non-competitive franchises included all four attributes appearing in the competitive model, plus an additional term measuring penetration (subscribers/homes passed) in the system.

The key analytical finding here is twofold, namely:

- franchises in small systems are demonstrably different from those in large systems; and
- the difference can be expressed in economic and technology terms.

All of the results supporting the discussion above are available as computer output given in Volume 2.

3.2 Cluster Analysis

Another analytical technique that is useful in searching for commonalities among a large number of observational units is Cluster Analysis. The objective in the context of this assignment was to create subgroups of sampled franchises whereby franchises within a subgroup possessed similar financial and economic characteristics, but the subgroups themselves would be substantively different. If the technique is reasonably successful, franchises within each subgroup would provide a sound basis for comparison, particularly with respect to average revenues derived from the survey.

In this analysis all 420 franchises were considered. As before, we focused on the set of cost/investment factors (23 variables in all) to form the clusters. Each variable is initially standardized by subtracting the mean of all 420 observations and dividing by the standard deviation. This step tends to convert all variables to comparable units prior to forming clusters, since variables with numerically large variances tend to have greater influence on cluster formation.

Results are summarized in Table 5. Five clusters included most of the franchises; fifteen franchises were distributed among five other clusters implying that their characteristics were somehow unique and dramatically different from the majority of sampled franchises.

Table 5. Summary of Rate Differences Within Franchise Clusters

Cluster ID[a]	Sample Subgroup	No. of Small Franchises	Average Revenue	No. of Large Franchises	Average Revenues
A (2)	Non-comp.	0	NA	15	$22.75
	Competitive	0	NA	1	24.74
B (3)	Non-comp.	35	$20.11	47	22.44
	Competitive	7	13.28	5	22.86
C (4)	Non-comp.	26	21.11	15	23.77
	Competitive	5	17.70	2	22.00
D (7)	Non-comp.	132	21.27	20	21.02
	Competitive	11	15.80	2	17.62
E (9)	Non-comp.	14	21.85	53	22.62
	Competitive	6	15.15	9	23.28
All Others	Non-comp.	0	NA	12	23.53
	Competitive	0	NA	0	NA

[a]Number in ( ) refers to Cluster ID number in computer output given in Volume 2.

Comparisons of average revenue (ARIEPS) within each of the four main clusters simply confirmed the contention that a competitive price differential exists only among franchises operated by small systems.

For the sake of completeness, we also determined the basic features of franchises clustered together. To do this, we performed a Principal Component Analysis (PCA) within each cluster to identify those attributes that were dominant in forming each cluster. Results are given in Volume 2 and discussed in Section 3.2 of the report.