First Year Load Impact Study of Southern California Gas Company's 1996 Commercial Energy Management Services Program

CPUC Study Identification Number 712

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Summary

First-year load impacts for Southern California Gas Company's 1996 Commercial Energy Management Services Program (CEMS) are presented below. CEMS efforts provided gas energy conservation information to core commercial customers throughout SoCalGas's service territory. The energy conservation recommendations are provided in person, typically by a SoCalGas account executive or intern. The SoCalGas representative conducts an on-site inspection of the customer's facility and recommends actions that would reduce natural gas consumption. The recommendations are based upon the SoCalGas representative's review of the customer's gas-using equipment and equipment practices. The results these program year 1996 audits were expected to achieve were average annual savings of 601 therms per audited customer.

The CEMS impacts are provided in Table 1. Table 1 summarizes total program results and net impacts for a typical audited customer.

Table 1
Net Therm Savings -
Customer Impacts, Customer Counts and Program Impacts

Group	Ex-Post Audit Impact (therms)	Ex-Post Audit Impact (% of use)	Ex-Post Customer Count	Ex-Post Program Impact (therms)
All Participants	127	1.25%	16,775	2,130,425

Notes: Audit impact per customer determined using the results of the conditional demand assessment for an "average" customer in terms of equipment saturations; Average use of 10,143 therms/year from analytic dataset overstates average use for the commercial sector since customers using less than 500 therms per year are underrepresented in the dataset and the audited population.

Annual-first year therm savings from 1996 program efforts averaged 127 therms per CEMS program participant. This is approximately one-quarter of the ex-ante value and one-half of the estimated savings from the 1995 Industrial Energy Management Services Program audit. This estimate is based upon savings calculated from the conditional demand assessment described later in this report. Appliance/equipment holdings were fixed at the saturation levels recorded from the analytic dataset for the purpose of calculating therm savings.

The ex ante goal of 13,000 CEMS audits was accomplished; the 1996 CEMS participant list included 16,775 customers. Customers that had some noncore usage at the premises totaled 219 dropping the number of core commercial audits down to 16556. The gas company changed billing systems in March, 1996 and some confusion existed regarding customer premise identification information. The billing system change prevented 1,380 customers from being matched to the customer name and address file in the new billing system and an additional 241 customers could not be matched with consumption information in the new billing system. A total of 14,935 customers remained for the sample design phase, but program savings are calculated based on the 16,775 audited customer count.

Table 2 shows pre and post audit annualized consumption for program participants and for the comparison group. As expected, program participants tend to have higher average annual consumption than the comparison group. This is due to the targeting of larger customers by the SoCalGas auditors. The comparison group was drawn from the entire commercial customer population, which encompasses commercial customers whose use is typical of residential customer levels.

Table 2
Annual Therm Usage Pre and Post Audit

Group	Pre Audit Use	Post Audit Use	Difference
Program Participants			
Surveyed Participants	13,323	13,183	140
Participants That Took Some Action	15,334	15,249	85
Non-Response Participants	9,242	9,500	(258)
Comparison Group			
Surveyed Comparison Group	6,404	6,236	168
Non-Response Comparison Group	5,475	5,694	(219)

Note: Comparison group customers were assigned an audit date of July 15, 1996 for pre and post usage comparisons.

It is possible that positive spillover impacts could have occurred due to SoCalGas effort. For example, it is likely that individual's responsible for reviewing and implementing audit recommendations will carry an enhanced awareness of energy saving actions to any subsequent employers. It is also likely that geographically proximate businesses will occasionally share cost saving advice, such as energy audit information. The effort required to estimate spillover impacts was felt to be too expensive relative to the potential benefits to be gained from the information. Direct audit savings for commercial sector customers are very challenging to quantify with any degree of accuracy. Quantification of spillover effects is much more difficult. Consequently no estimation of spillover effects was attempted.

Therm values defining the 90% and 80% confidence levels for each customer group are provided in the section entitled Usage Estimates and Therm Savings.

Introduction

The 1996 Commercial Energy Management Services Program (CEMS) provided energy efficiency information for core commercial customers throughout the SoCalGas service territory. The information consisted, primarily, of recommendations aimed at using natural gas more efficiently in key space conditioning and process equipment. The major types of equipment targeted in the commercial core markets were: water and space heating boilers, conventional water heaters, space heating furnaces, laundry dryers, and cooking equipment. The major business groups receiving audits were: restaurants, lodging places (hotels/motels), laundries, schools, and health facilities.

Audit Delivery

SoCalGas account executives and interns assigned to core commercial customers have the primary responsibility for conducting energy audits under the Company's CEMS program. These staff are all trained regarding:

- General principles of combustion and combustion technology
- Building shell efficiency measures
- water and space heater operations and efficiency principles
- Cooking equipment efficiency measures

In addition they have access to a SoCalGas technical staff with knowledge of industry-specific energy technologies. SoCalGas staff are particularly well-acquainted with energy-efficient cooking equipment, gas-fired melting technologies, gas engines, furnaces, and boilers.

The account executives responsible for are commercial customers are assigned by geographic area. They provide customers in their assigned area energy efficiency advice, arrange for SoCalGas energy service technicians to conduct flue gas analyses and equipment adjustments, answer billing questions, and arrange for changes in service.

The account executives are assisted by thirty to forty SoCalGas interns assigned to the various SoCalGas field offices. Interns are engineering undergraduates drawn from local colleges and universities. The interns are trained to conduct energy analyses and to make recommendations for energy efficiency improvements. They are responsible for contacting

SoCalGas customers whose consumption is less than 50,000 therms annually. Consequently, they focus their efforts primarily upon commercial customers.

After completing their energy-efficiency training, interns are placed at a SoCalGas field office and assigned a geographic area in which to conduct energy audits. The interns first generate a list of possible audit candidates using the Market Analysis System (MAS) database. This database is used to track customer contact and audit efforts.

The interns identify their geographic area of interest and MAS provides a list of customers within that area who have not received an audit within the past 12 months. The generated customer list is sorted by street address. The interns call groups of physically proximate customers to schedule audits or, occasionally, travel door-to-door offering free energy audits to customers on their list. The majority of customers who are contacted by SoCalGas staff agree to receive the audit. Anecdotal evidence suggests that less than ten percent of contacted customers refuse the audit. Refusals are typically due to a concern about letting anyone into the facility or a concern about taking the time to interact with the auditor.

The commercial and industrial audits take anywhere from 30 minutes to two days to complete, depending upon the complexity of the customer's operations and the extent to which the customers are willing to take time with the energy auditor. Most commercial audits, with the exception of health facilities, are accomplished within two hours.

SoCalGas customer representatives, both account executives and interns, have a set of two recommendation checklists that can be employed as an aid to the audit process. One checklist is generally used across all non-residential customer groups. The second checklist is specific geared to kitchen equipment. A copy of the general checklist is shown in Figure 1.

Figure 1
Audit Recommendation Checklist

COMMERCIAL/INDUSTRIAL ENERGY EFFICIENCY ANALYSIS
RECOMMENDATION CHECKLIST

NAME OF BUSINESS | GAS ACCOUNT NUMBER | DIVISION

BUSINESS ADDRESS | CITY | ZIP CODE

PERSON CONTACTED | PHONE NUMBER

ACTION CODES
Y = CUSTOMER HAS TAKEN ACTION PRIOR TO ANALYSIS
N = NO ACTION TAKEN, AND NO RECOMMENDATION
R = ADVISED TO TAKE THIS ACTION
A = ACTION TAKEN SINCE INITIAL SURVEY (ANALYSIS REVIEW ONLY)

GAS USAGE

	YEAR	MONTH	THERMS
ANALYSIS ☐			
ANALYSIS REVIEW ☐			

BOILERS

01 FREQUENT ADJUSTMENT/CLEANING OF BURNER(S) EITHER AUTOMATICALLY WITH AN OXYGEN TRIM SYSTEM OR MANUALLY UTILIZING A FLUE GAS ANALYZER ON A STRICT SCHEDULE (3-6%) ____
02 INSTALLATION OF STEAM/HOT WATER PIPE INSULATION (AND INSULATION ON OTHER COMPONENTS SUCH AS THE REAERATOR TANK, CONDENSATE RETURN LINE AND END-USE APPLIANCE WHERE APPROPRIATE) (2-10%) ____
03 INSTALLATION OF CONDENSATE RETURN LINES WHERE SIGNIFICANT VOLUMES EXIST (5-20%) ____
04 INSTALLATION OF PROPERLY FUNCTIONING STEAM TRAPS (2-5%) ____
05 INSTALLATION OF WATER SOFTENER AND/OR FREQUENT REMOVAL OF SCALE FROM HEAT EXCHANGE SURFACES (3-10%) ____
06 USE OF LOWEST TEMPERATURE/PRESSURE OF HOT WATER/STEAM THAT PROCESS WILL ALLOW (1-3%) ____
07 INSTALLATION OF TURBULATORS IN FIRETUBES TO IMPROVE HEAT TRANSFER (2-8%) ____
08 PREHEAT FEEDWATER WITH WASTE HEAT (ECONOMIZER OR BLOWDOWN RECOVERY) – DO NOT INCLUDE HEATING DEAERATOR TANK WATER WITH BOILER STEAM (5-15%) ____
09 TIMERS ON HOT WATER CIRCULATING PUMPS (20-30%) ____

IF BOILER IS USED FOR SPACE HEATING ADD:

10 SPACE HEATING SHUT OFF (OR VERY LOW) AFTER HOURS AND DAYS CLOSED (10-20%) ____
11 THERMOSTATS SET LOW (68°F) DURING HEATING SEASON (4%) ____
12 ROOF/CEILING/ATTIC INSULATION (R-19) (10-20%) ____
13 TIGHT BUILDING SHELL WITH CLOSED WINDOWS AND DOORS **AND** WEATHERSTRIPPING/CAULKING (5-10%) ____
14 USE OF ACTIVE SOLAR SPACE HEATING (50%) ____
15 OTHER _____ ____

OTHER EQUIPMENT

☐ KITCHEN
☐ DRYERS
☐ PRIME MOVERS
☐ FURNACES
☐ HEATER
☐ OTHER _____
☐ TANKS (SOLUTION)
☐ WASHERS
☐ KILNS
☐ ATMOSPHERIC GENERATOR
☐ OVENS
☐ TORCHES

WATER HEATERS

01 WATER TEMPERATURE SET AS LOW AS POSSIBLE (120°F) FOR NON-SANITARY USES (5-10%) ____
02 INSTALLATION OF FLOW RESTRICTORS WHERE APPLICABLE (SHOWERS, WASH BASINS ETC.) (UP TO 50%) ____
03 INSTALLATION OF WATER HEATER BLANKET (3%) ____
04 REGULARLY CLEAN HEAT EXCHANGE SURFACES (BY DELIMING AND/OR USING WATER SOFTENER) (10-15%) ____
05 SHUT CIRCULATING PUMPS OFF AFTER-HOURS, WHERE APPLICABLE (CLOSED LOOP SYSTEMS) (20-30%) ____
06 INSTALLATION OF HOT WATER PIPE INSULATION (ESPECIALLY FOR CIRCULATING, CLOSED LOOP SYSTEMS) ____
07 CALL GAS COMPANY CUSTOMER SERVICES FOR FREE BURNER CALIBRATION ____

SPACE HEATERS

01 THERMOSTATS SET LOW (68°F) DURING HEATING SEASON (4%) ____
02 SPACE HEATING SHUT OFF (OR VERY LOW) AFTER-HOURS AND DAYS CLOSED (10-30%) INVESTIGATE INSTALLATION OF TIMERS ____
03 TURN PILOTS OFF IN SUMMER MONTHS OR USE IID'S ____
04 ROOF/CEILING/ATTIC INSULATION (R-19) (10-20%) ____
05 TIGHT BUILDING SHELL WITH CLOSED WINDOWS AND DOORS, **AND** WEATHERSTRIPPING/CAULKING (5-10%) ____
06 EXISTENCE OF DUCT INSULATION WHERE DUCTS RUN THROUGH UNCONDITIONED AREAS (5-15%) ____
07 OTHER _____ ____

AIR CONDITIONERS

01 THERMOSTATS SET HIGH (78°F) DURING COOLING SEASON (0-10%) ____
02 EQUIPMENT SHUT OFF AFTER-HOURS AND DAYS CLOSED (5-10%) ____
03 ROOF/CEILING/ATTIC INSULATION (R-19) (5-15%) ____
04 TIGHT BUILDING SHELL WITH CLOSED WINDOWS AND DOORS, **AND** WEATHERSTRIPPING/CAULKING (2-5%) ____
05 INSULATED DUCTS IN NON-CONDITIONED AREAS (2-5%) ____
06 REGULAR/AUTOMATIC USE OF AN ECONOMIZER CYCLE (20-50%) ____

REMARKS _____

	YES	NO
OBSOLETE EQUIPMENT REPLACEMENT SUGGESTED?	☐	☐
CUSTOMER REQUIRES FOLLOW-UP?	☐	☐

IF YES, DESCRIBE _____

SURVEY CONDUCTED BY _____

DATE _____

X _____
CUSTOMER SIGNATURE

	YES	NO
SEND LETTER?	☐	☐

SOUTHERN CALIFORNIA GAS COMPANY FORM 6375-A (21)

As seen in Figure 1, conservation measures are identified for process boilers, space heating boilers, generic space heaters, and water heating energy use. Generic air conditioning (either gas-fired or electric) and shell insulation recommendations are also made when appropriate. The boiler measures include pipe insulation, burner adjustments, steam trap cleaning and repair, and scale removal, among others. Space heating-related measures include ceiling insulation, weather-stripping, caulking, and duct insulation. The water heating-related measures included: water heater blankets, faucet aerators, and pipe insulation. The form contains space for the suggestion of conservation measures for specialized equipment such as dryers.

The audit is not limited to these recommendations. The auditors are free to make any suggestions that are appropriate given the customers actual equipment holdings, business processes, and energy-using practices. The form provides a convenient reminder of actions that should be routinely undertaken by each customer. In fact, much of the benefit of SoCalGas audit actions is the constant energy efficiency reminder they provide customers.

Report Objectives

This report summarizes the results of a statistical analysis aimed at estimating the first year load impacts of the SoCalGas 1996 CEMS Program. The *Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings From Demand-Side Management Programs, January 1997 revision* (Protocols) do not require calculation of equipment or end-use specific audit impacts. End-use specific estimates are required for "lighting, motors, and other." Since there are no gas lights or motors (or at best very few) on SoCalGas customer premises, all end-uses fall into the "other" category, functionally equivalent to calculating aggregate audit impacts.

In spite of this, the intent was to provide end-use specific impacts. The effort required to obtain robust estimates of natural gas audit savings for commercial customers is extensive. A key element is obtaining reliable equipment capacity and utilization factors, particularly for customers who use gas for non-space conditioning, i.e., process, purposes. Without knowing when business changes or conditions affect energy use and by how much the changes in business conditions alter use, audit impacts are masked. Commercial customers are very reticent about providing "production" information to outsiders and are typically not knowledgeable about the capacity of their equipment.

We were able to employ conditional demand analysis (CDA), a preferred technique according to the Protocols. CDA is a statistical technique that disaggregates monthly therm consumption data into appliance-specific average usage. The technique employs customer-specific monthly therm usage both before and after the audit, combined with customer-specific equipment holdings, to estimate changes in energy usage. Customer-specific production information and regional weather data are also directly employed in the CDA estimation process.

The data employed in the analysis, and its development, are outlined below in the section entitled Analytic Data Set Development. The estimation of the regression model is described in the section entitled Model Development and load impacts are included in the section entitled Usage Estimates and Therm Savings Impacts. Appendices include the participant survey instrument and detailed regression results. The analytic dataset (merged billing data and survey data), SAS program files used to prepare the analytic dataset and run the final regressions, and the SAS System output for the final set of customer specific models are filed with this report.

Analytic Data Set Development

This section describes the development of the data used in the analysis of the 1996 CEMS first year usage impacts. The required analytic data set was created from the integration of five separate data sets: the 1996 program participant file and other data from the MAS database, SoCalGas's customer information file, SoCalGas's customer billing file; the heating degree day file, and the 1996 CEMS Survey file. The relationship of these datasets with respect to the development of the analytic data set is shown in Figure 2. A brief description of each data set follows.

Program Participation Records

SoCalGas maintains the CEMS program tracking file on the PC based Market Analysis System (MAS). The MAS system logs the date of the initial audits, post audit visits, and other interaction with SoCalGas customers, as well as specific information about each of those types of interactions. MAS also provides links (premise identification numbers and account numbers) necessary to obtain billing and other information for each audited customer.

The program participation file, which is derived from MAS, contains data vital to the estimation of load impacts. Key data fields include the following:

- Audit date
- Premise and account identification numbers (used to match billing records to the customer)
- Customer name (i.e., business name)
- Customer contact name
- Customer phone number
- Address (used to assign weather data and in the survey implementation)
- Equipment holdings (type, number, and capacity)

With the exception of equipment holdings, the data fields listed above are almost universally populated in the MAS database. The availability of equipment holdings data is

contingent upon the customer being visited by a SoCalGas representative who collected equipment information and transcribed said information into MAS, or CIGUS (the predecessor to MAS).

In May, 1996, MAS acquired the ability to store detailed audit information, including equipment-specific recommendations. This information was not used in the analysis because only one-half of the 1996 CEMS audit participants had any detailed information resident in MAS. There is no formal process to determine and record which recommended energy conservation actions are adopted by audited customers. Consequently, the details provided in MAS are dependent upon the attitude of and time available to individual SoCalGas representatives who input the data after an audit.

Customer Information Data

The customer information database is part of SoCalGas's Customer Information System. This system is an integral part of the Company's billing system. Besides customer name and address, the Standard Industrial Classification (SIC) is stored in the customer information data base. This file was used to develop a comparison group, stratified by business class, for the 1996 CEMS survey.

Billing Data

Gas consumption data was obtained from the customer billing files maintained by SoCalGas. Billing data files are "extracted" from SoCalGas's Customer Information System on a routine and regular basis. The customer billing file contains monthly therm usage for each SoCalGas customer. The correct billing data for each program participant was obtained by matching the premise and customer identification numbers on the CEMS participation file with those on the customer billing file. This matching process is superior to matching upon account number because account numbers may change as accounts are refolioed (i.e., as billing cycles and routes are changed for individual customers or groups of customers). Monthly 1996 billing history for 241 participants was not found in company billing files and these customers were removed from further analysis.

Key participant-specific information obtained from the customer billing files included:

- monthly therm consumption for each 1996 CEMS participant from September, 1994 through November, 1997

- meter read dates

- monthly billing days

Monthly billing days are used to determine average daily use. Average daily use, in conjunction with meter read dates, is employed to construct calendar month consumption figures for each customer. This is needed in order to accurately pool customers for the CDA regression models.

Weather Data

Weather variables were created to account for the effect of weather on space heating energy use and on water heating energy use. For space heating, a set of climate area and billing cycle-specific "heating degree days" variables with a 65 degree Fahrenheit base were created. Daily temperatures were employed to create daily heating degree variables over the billing data time frame. These daily values were aggregated into monthly values for each combination of six SoCalGas weather zones and each possible billing cycle. An identical process was undertaken using normalized weather (a file of thirty year average weather data maintained by SoCalGas for its service territory and climatic subregions). This process allowed customer-specific weather to be employed in the estimation process.

The heating degree day weather variable (both actual and 30 year normalized) was merged with the billing data using address and billing cycle information. The "actual" variables were used for estimation of savings, while the "normalized" variables were used for the calculation of program impacts.

Program Survey

A mail survey of 1996 CEMS program participants and non-participating commercial customers was conducted. The aim of the survey was to obtain production data, equipment data, and equipment utilization information needed to estimate a regression model of monthly gas consumption that would allow conservation impacts to be identified.

The first steps involved development of a survey instrument for both the participant group and a non-participant comparison group. Copies of the survey instruments are included in Appendix A. The surveys focused on determining:

- Recollection of the audit

- Recollection of suggested energy conservation actions and their current disposition
- Equipment holdings (type, number, capacity, utilization rates)
- Equipment additions within the pre and post audit evaluation timeframe
- Operating hours and/or production data (in the case of customers who also employ gas-fired equipment for non-space conditioning purposes, e.g., laundries, restaurants)

At the same time the selection of an appropriate sample frame was begun. Based upon an examination of the SoCalGas commercial customer mix six business groupings (defined by SIC code) were formed to supplement the consumption-based stratification envisioned for the sample frame. The first five business groups include restaurants, laundries, lodging places (hotels/motels), education facilities, and health facilities. The sixth group was "other," the remaining customer groups after the first five were removed. The first five were selected based upon their large number and/or therm consumption within the audited group. Table 3 provides SoCalGas commercial customers and audited customers for each of the business groups.

Table 3
1996 Audit Participants by Business Sector

	SoCalGas Commercial Customers			Sample Frame - Surveyed		Sample Frame - Not Surveyed	
Sector	Total	Partic.	Non-Prtc.	Partic.	Non-Prtc.	Partic.	Non-Prtc.
Restaurant	27,241	7,373	19,868	186	60	1,260	468
Lodging	3,939	851	3,088	55	69	324	459
Laundry	5,468	1,894	3,574	163	64	909	447
Health	3,656	336	3,320	41	71	203	481
Education	5,876	613	5,263	84	66	336	470
Other	40,640	3,313	37,327	145	162	834	1,158
Total	86,820	14,380	72,440	674	492	3,866	3,483

Notes: Does not include customers using less than 500 therms annually, except for restaurants

Customers who had participated in SoCalGas's Commercial Equipment Replacement Program during 1995 or 1996 were not considered for inclusion in the participant or comparison group samples. Their inclusion would have increased the difficulty in

obtaining robust CEMS program savings estimates and would have added no benefit to the assessment.

Customers that had not received audits in 1995 and 1996 were selected as potential comparison group customers. Using Neyman allocation stratified random sampling techniques, participant and comparison group sample sizes were determined and a sample frame selected.

Testing For Sample Nonresponse Bias

As discussed previously the customers in the commercial market were segmented into the following six business types based on the SIC code distribution of the 1996 Commercial audit participants: Restaurant, Lodging, Laundry, Health, Education, and Other.

The six business types were further segemented into six consumption strata based on Delanius-Hodges techniques to minimize the standard deviations in usage within each business type. The initial strata usage levels for each business type are displayed below in Table 4.

After the completed surveys were returned and a database of respondents created, nonresponse bias tests were performed to make certain that the weights attached to survey respondents accurately represents the 1996 commercial population. The nonresponse bias tests were performed by comparing average 1996 respondent usage to average 1996 usage of the non-respondents by strata for each of the six business types.

Using the average annual usage values and standard deviations, t-ratios were generated and the null hypothesis that no significant difference existed between respondent and non-respondent average use was tested. The null hypothesis was rejected when the test statistic value was greater than 1.96. Table 4 below shows the results of the nonresponse bias tests for the strata in each of the six business types.

Table 4
Initial Nonresponse Bias Test Results

				Non-Respondents			Respondents			
Type	Strata	Usage	Sample	n	Mean	Std	n	Mean	Std	t-Test
Rest.	1	1 - 2K	152	135	800	606	17	863	739	-.34
Rest.	2	2K - 6K	536	472	3886	1121	64	4185	1197	-1.89
Rest.	3	6K - 10K	320	282	7820	1137	38	7885	926	-.40
Rest.	4	10K - 17K	352	308	12861	2110	44	12879	2050	-.05
Rest.	5	17K - 44K	536	471	23383	5607	65	23982	6199	-.74
Rest.	6	>= 44K	78	60	67151	22136	18	71089	36018	-.44
Lodging	1	500 - 2.5K	56	50	1398	601	6	1709	575	-1.24
Lodging	2	2.5K - 12K	376	431	5493	2563	45	6338	3043	-1.78
Lodging	3	12K - 29K	208	181	18247	4663	27	19493	4623	-1.30
Lodging	4	29K - 65K	161	138	43098	10590	23	38652	7280	2.52
Lodging	5	65K - 150K	88	67	95281	23265	21	96375	23096	-.19
Lodging	6	>= 150K	18	15	171301	14584	3	199993	35381	-1.38
Laundry	1	500 - 3.5K	144	126	1568	1055	18	2224	1208	-2.19
Laundry	2	3.5K - 9.5K	520	455	6158	1605	65	6200	1562	-.20
Laundry	3	9.5K - 17K	328	287	12757	2079	41	12850	2399	-.24
Laundry	4	17K - 30K	318	282	22623	3730	36	21704	3420	1.50
Laundry	5	30K - 95K	246	191	41171	11772	55	48413	16601	-3.02
Laundry	6	>= 95K	27	15	141606	34684	12	149578	38328	-.56
Health	1	500 - 2.5K	72	63	1130	619	9	885	468	1.41
Health	2	2.5K- 20K	392	344	9021	4959	48	9047	4469	-.04
Health	3	20K - 36K	228	112	27139	4436	16	27137	5410	.01
Health	4	36K - 75K	124	104	50153	11168	20	51848	12948	-.55
Health	5	75K - 150K	62	50	103547	19281	12	108082	20633	-.69
Health	6	>= 150K	18	11	182386	28923	7	188663	23610	-.50
Educ.	1	500 - 2.5K	80	70	1535	591	10	1453	514	.46
Educ.	2	2.5K - 8.5K	344	302	4916	1572	42	4855	1610	.23
Educ.	3	8.5K - 25K	271	227	14001	4522	44	14158	4793	-.20
Educ.	4	25K - 60K	139	130	38021	9249	30	38300	10423	-.13
Educ.	5	60K - 125K	88	70	82406	17796	18	79178	12705	.88
Educ.	6	>= 125K	34	28	155833	28874	6	173169	38372	-1.05
Other	1	500 - 974	128	111	696	132	17	740	140	-1.19
Other	2	975 - 5.5K	688	603	2275	1202	85	2598	1221	-2.29
Other	3	5.5K - 18K	632	553	9972	3602	79	9949	3636	-.18
Other	4	18K- 47K	464	407	27553	7915	57	31425	8297	-3.28
Other	5	47K - 150K	338	277	75928	25506	61	80527	27146	-1.21
Other	6	>= 150K	49	39	188840	26490	10	180536	28859	.83

Several of the t-Test statistics had values greater than 1.96 suggesting that nonresponse bias may exist. Note that some customers were included in the non-respondent category because sufficient completed surveys had been performed in that particular business type, strata combination. Nevertheless, the bias was addressed by using annual therm use to substratify each strata for which the t-Test was greater than 1.96. The business type and strata that were affected along with the new consumption breakpoints are listed below:

- Lodging 4 55000
- Laundry 1 2500
- Laundry 5 45000
- Other 2 1700
- Other 4 30000

The results of the nonresponse bias tests after substratifying the five strata listed above appear in Table 5.

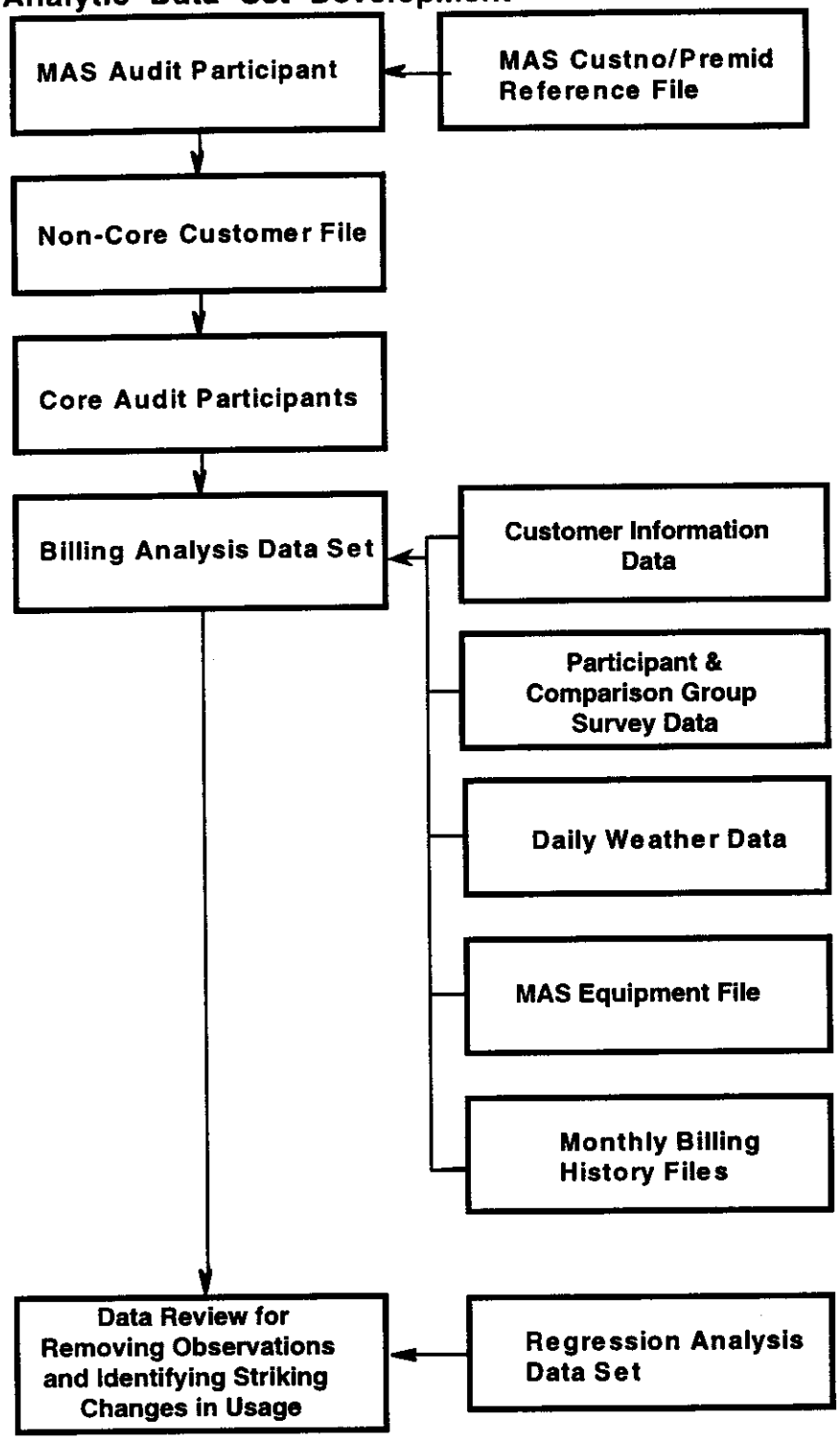
Table 5
Nonresponse Bias Test Results After Substratification

				Non-Respondents			Respondents			
Type	Strata	Usage	Sample	n	Mean	Std	n	Mean	Std	t-Test
Lodging	4	29K - 55K	137	114	39581	7917	23	38651	7280	.55
Lodging	4	55K - 65K	24	24	57320	1295	-	-	-	-
Laundry	1	500 - 2.5K	102	98	1021	532	8	948	360	.52
Laundry	1	2.5K- 3.5K	42	32	3177	237	10	3246	222	-.84
Laundry	5	30K - 45K	174	146	35721	4112	28	35541	3903	.22
Laundry	5	45K - 95K	72	45	58556	11145	27	61761	13896	-.92
Other	2	975 - 1.7K	289	263	1288	207	26	1305	204	-.41
Other	2	1.7K - 5.5K	399	340	3039	1093	59	3167	1030	-.88
Other	4	18K- 30K	305	278	22878	3406	27	23966	3406	-1.58
Other	4	30K - 48K	159	129	37627	4884	30	38138	5228	-.49

Inconsistency and Consumption History Screens

Figure 2 provides a graphic display of how the analytic data set was developed. A billing analysis data set was created by merging the customer information data, survey data, weather data, MAS equipment file and billing histories. The resulting billing analysis data set was reviewed prior to creating the data set used in the regression analyses.

Figure 2
Analytic Data Set Development



The survey results and customer billing histories were reviewed for obvious anomalies. Particular attention was paid to variables that were known to be important in obtaining robust savings estimates from the regression analysis.

For example, the monthly production index is an important variable in explaining seasonal fluctuations in energy use. More than 70 of the 1166 completed surveys had edits made to the production series due to apparent key punch mistakes in building the data series (e.g. production number increasing 1000 fold for a single month).

The Protocols require a minimum of twelve months of pre installation consumption history and nine months of post installation period consumption history for inclusion in the conditional demand analysis. Billing history information was collected from September, 1994 through November, 1997. A total of 30 surveyed program participants and 42 surveyed comparison group respondents were dropped from the analysis because the Protocol minimum consumption history requirements were not achieved.

The survey respondents provided information on equipment counts and when equipment holdings changed between 1995 and 1997, but either did not know or refused to answer equipment capacity questions. This severely limited the usefulness of the survey and necessitated use of the equipment file portion of the MAS system. Equipment capacity data used in the analytic data set was obtain from the MAS system. These data were collected by SoCalGas staff during audit or other visits to the customer site.

Customers without capacity data in MAS were dropped from the regression analysis. A total of 32 surveyed program participants did not have equipment capacity information in MAS and 120 comparison group customers were dropped due to a lack of equipment capacity data.

Customer usage was also examined. Customers whose usage changed by more than 15 percent between 1996 and 1997 were tagged. A total of 211 CEMS surveyed participants and 140 comparison group respondents were tagged. These customers were excluded from the regression analysis selected as providing the most reasonable results (discussed in the Conditional Demand Model Development section below). An alternative regression was run with those customers included. Audit savings estimates were very similar to those obtained from the dataset that excluded customers whose '96-'97 usage changed by more than 15%, but the result were less robust from a statistical standpoint. Confidence intervals were very wide when compared to the regression selected as providing the most appropriate estimates.

A summary of the survey respondents remaining after the various screens appears below.

Table 6
Survey Responsdent Attrition

Category	Participant Group	Comparison Group
Initial Respondents	674	492
Respondents with Sufficient Billing History	644	450
Respondents with Equipment Capacity Data (*data set for alternative model*)	612	330
Respondents with Consumption Change Not >15% from '96-'97 (*data set for selected model*)	401	190

Variable used in the analytic data set are listed in the model discussion that follows. They are also listed in Appendix B. Appendix B includes summary statistics for variables used in the CDA, as well as a correlation matrix for the variables.

Conditional Demand Model Development

The primary objective of the monthly energy use model developed from the merged survey and billing record data base (i.e., the analytic data set) was to measure the impact of audit recommendations on energy use for specific types of commercial equipment.

Total usage and conservation savings are provided in Table 1 within the Summary section of this report. They are also included in Tables 9, 10, and 11 within Appliance Usage Estimates and Therm Savings Impacts, following this section. Space heating equipment usage and related audit conservation savings are estimated under normal weather conditions as required by the Protocols.

A detailed presentation of the 1996 CEMS monthly energy use and load impact equation is provided in this section. An overview of the estimation technique and data sources employed is described first, then the overall energy demand equation is presented. Finally, the equipment-specific equation results are presented with an interpretation of the coefficients.

Estimation Technique

The estimation technique used in this study is conditional demand analysis. The conditional demand technique provides a method of distributing total customer natural gas consumption among the gas-using equipment present in the building. In addition, the technique allows estimation of changes in equipment use due to the installation of conservation actions, e.g., changes in equipment utilization, equipment "tune-ups," and/or equipment changeouts.

Conditional demand analysis was used in lieu of other approaches for two reasons. First, the approach had been successfully employed to assess the residential audit programs conducted by SoCalGas. Second, other approaches either did not provide the detailed results CDA would afford (i.e., results at an end-use basis for various types of program participants) or would have demanded information that was unavailable (e.g., reasonably accurate energy use priors for individual end-uses across many types of customers).

A change in consumption model, where the change in usage is modeled as a function of the change in weather, as well as changes in conservation from the previous year, was also considered in the early stages of this study. Robust, end-use specific usage estimates could not be derived, so the approach was discarded.

The potential need to correct for self-selection bias was also considered. Self-selection bias occurs when unobservable factors influence participation in a program and behavior within that program. It is a common problem with rebate programs. A customer may, for example, be more likely to engage in a rebate program offering if he is ready to expand operations or regularly self-audits energy use at his facility. He may engage in an audit program with the hope of obtaining a rebate, because he knows he is more likely to get a rebate if he takes an audit. These situations signal unusual latent behavior that may not be representative of customers as a whole. Consequently, to draw inferences about an entire population (i.e., all energy customers) from a group with such predilections is unwise. The group is not representative.

This type of situation does not present itself with SoCalGas's 1996 CEMS Program. Audit participants are selected by SoCalGas representatives. While the selections are not completely random (customers audited the previous year are not selected and larger customers tend to be selected over smaller customers), self-selection bias is not an issue since participants do not self-select. The only possible exception is raised by those who refuse to be audited. They do, however, represent less than 10% of the participant group by number (according to persons responsible for the CEMS program) and do not appear to select-out of the program for reasons that would bias energy savings estimates to any appreciable extent.

The conditional demand technique is based on the proposition that the natural gas use of each customer is the sum of the natural gas used by each of the equipment in the business. In mathematical terms, natural gas use is expressed as:

Use = gbo*GB + gsh * GSH + gwh * GWH + grg * GCK + gdy * GDY + go * OTHER

where:

Use	is customer consumption
gb	is gas boiler consumption
GB	is a gas boiler indicator variable
gsh	is gas space heating use
GSH	is a gas space heat indicator variable
gwh	is gas water heating use
GWH	is a gas water heating indicator variable
grg	is gas cooking use
GCK	is a gas cooking indicator variable
gdy	is gas dryer use
GDY	is a gas dryer indicator variable
go	is other equipment use
OTHER	is an other equipment indicator variable

The indicator variables take the value of 1 if the equipment is present in the business and 0 if the customer does not own or operate the equipment. Mean values of equipment indicators (equipment saturations) appear in Appendix B.

For each of the above mentioned equipment types, a usage equation is created. The usage equation relates the expected use of a particular equipment type to key factors that will influence its monthly use. For example, the number of operating hours and capacity of the tank will affect water heater use, capacity of the furnace and weather conditions will affect space heating use, and conservation measures will affect the monthly consumption of associated equipment.

Information for every factor is required for each surveyed respondent. The data elements integrated to estimate the equipment equations include:

1) survey data on equipment ownership, business characteristics, and changes in the number of the existing equipment,

2) program participant information regarding the date of the audit,

3) monthly consumption, meter read date and billing days from company billing records, and,

4) weather data (in heating degree days) in the temperature zone in which each household is located and for the time period covered by each energy bill.

The sources for these data elements were outlined in the section, Analytical Data Set. The discussion that follows details the process of using that data to estimate conditional demand models of equipment energy use.

Estimation Process and Regression Results

A three stage estimation process was employed to obtain a regression model from which reasonable appliance usage estimates and therm savings impacts could be determined. In addition to employing a sound, established theoretical framework, reasonable estimates, from an econometric standpoint, are estimates of regression coefficients that are unbiased and consistent. An unbiased estimate fairly represents the true value of what it is estimating; drawing repeated samples of the same number of program participants and recalculating audit savings would yield, on average, an unbiased estimate. Consistency refers to sampling distribution. As the sample size grows, a consistent estimator is one in which the sample distribution becomes more tightly concentrated around the true value of what is being estimated, rather than concentrating around another value.

Traditional econometric theory clearly defines how the properties (e.g., unbiasedness and consistency) of estimated regression coefficients and their estimated standard errors depend on the error structure of the model employed. If the regression error terms are serially correlated (i.e., the value of residuals follow a pattern determined by the value of preceding residuals) or heteroskedastic (i.e., the magnitude of residual values are related to the value of some other variable), the estimated coefficients can be unbiased and consistent, but the standard errors of the coefficients are inconsistent. If the standard errors are inconsistent, hypothesis tests conducted with them may be inaccurate. Of more direct importance to this

study, the 90% and 80% confidence intervals developed around the usage and savings estimates would be inaccurate.

The error structure of a model based on a pooled cross-section and time-series data set is likely to be cross-sectionally heteroskedastic and time-wise autoregressive. A CDA model requires a pooled cross-section and time-series data set. Consequently, a CDA model should be tested for serial correlation and heteroskedasticity. Corrections for the presence of serial correlation and/or heteroskedasticity in the error structure should be undertaken, when evidence of these two problems is discovered.

Both of these problems were discovered during the estimation of the conditional demand model for the 1996 CEMS. This prompted the use of a three-stage process to develop acceptable estimates of equipment usage of conservation savings. The first stage involved the development of the basic model, its estimation using ordinary least squares, and testing for serial correlation. The second stage involved correcting the first stage results for the presence of serial correlation and testing for heteroskedasticity. The third stage involved correcting the second stage results for the presence of heteroskedasticity. The summary appliance usage and conservation impacts provided in this report employ the third stage model results.

As discussed in the analytic data set portion of the report, customers that had more than 15% change in usage between 1996 and 1997 were dropped from the analysis. An alternative model was estimated including those customers. The alternative model produced similar results to the model discussed below for the first two stages, but very large error terms created convergence problems in the final stage. The results of the alternative model are provided in Appendix D (using the same relative equipment usage weights as was used in the model expressed below). Another option would be to eliminate customers with very large changes in use (e.g. over 50%) but that approach was not undertaken since customers that reduced use by 40% (too great an impact to be expected from a walk-through audit) would overwhelm calculated audit impacts.

First Stage - Ordinary Least Squares

This stage involved the estimation of a regression equation using ordinary least squares. The initial assumption was that the error terms were not serially correlated, nor heteroskedastic.

The CEMS equation was estimated using September, 1994 through November, 1997 billing year data. All customers had at least one year of consumption history prior to the installation of conservation and at least nine months of post conservation installation consumption history, as required by the Protocols. The regression equation was weighted to adjust for varying lengths of consumption history present. The weight equaled the inverse of the ratio of monthly observations for the customer divided by the average number of observations for all customers.

The first stage equation yielded an adjusted R-squared value of .554 which is typical for this type of analysis where the R-squared value is calculated assuming no intercept term exists. Table 7 summarize the coefficient values and associated t-ratios for the three stages of the preferred model. Appendix B contains definitions of the model variables as well as summary statistics (mean, standard deviation, minimum and maximum) for the untransformed variables of the first stage. Appendix C contains the detailed SAS System regression results for all three stages.

The results are what was generally anticipated during the formulation of the original specification. Interpretation of individual coefficients is discussed below in the Equipment Specific Gas Use Estimation section.

Table 7
Commercial Model Results

Variable	First Stage Coeff	First Stage t-ratio	Second Stage Coeff	Second Stage t-ratio	Third Stage Coeff	Third Stage t-ratio
BOILD	69.94	28.1	224.41	16.9	252.87	14.5
BOILLN	-165.40	-4.3	-282.81	-7.3	-128.63	-1.3
BOILLP	584.78	21.3	265.07	10.8	156.50	4.2
HEAT	3.52	42.8	2.27	58.5	1.01	33.7
SCAP	.58	3.6	1.51	12.7	1.73	36.8
SCAPN	-3.61	-6.6	-4.03	-11.3	-3.55	-5.6
SCAPP	4.99	8.1	4.79	13.4	4.63	5.8
WATERL	2.34	14.6	3.09	13.1	2.85	14.1
WATERLL	6.44	10.3	5.82	12.0	6.56	28.9
WATERLN	-1.26	-.4	2.54	.8	.10	.1
WATERLP	-3.62	-1.2	-2.40	-.8	-.98	-.9
COOKL	9.58	40.8	8.26	21.8	7.74	23.3
COOKLR	3.17	10.4	4.59	9.2	4.82	13.9
COOKLN	4.33	2.4	.82	.5	-1.13	-1.0
COOKLP	1.76	1.9	.99	1.5	1.13	1.6
DRYERL	19.05	31.9	14.05	17.0	13.12	21.5
DRYERLL	-12.98	-21.0	-8.06	-8.5	-7.47	-9.7
DRYERLN	-1.79	-1.1	-.53	-.3	-.26	-.4
DRYERLP	40.06	17.3	13.80	5.3	-3.66	-1.5
TALOAD	6.05	34.6	5.79	34.1	5.64	12.0
STOCKP	-.05	-3.3	.01	.8	-.03	-3.6
STOCKPM	-293.22	-2.8	-109.82	-1.3	-89.18	-2.5
CER	256.64	3.6	260.17	3.5	129.88	4.0

where:

BOILD	boiler capacity
BOILLN	boiler capacity * decrease boiler number indicator
BOILLP	boiler capacity * increase boiler number indicator
CER	CER participant indicator

COOKL	cooking capacity * index * hours
COOKLN	cooking capacity * decrease cooking number indicator
COOKLP	cooking capacity * increase cooking number indicator
COOKLR	cooking cap * hours * index * restaurant sector indicator
DRYERL	drying capacity * index * hours
DRYERLL	drying capacity * hours * index * laundry sector indicator
DRYERLN	drying capacity * decrease dryer number indicator
DRYERLP	drying capacity * increase dryer number indicator
HEAT	space heating capacity * HDD
SCAP	space heating capacity * index * hours
SCAPN	space ht capacity * decrease space heat number indicator
SCAPP	space ht capacity * increase space heat number indicator
STOCKP	(BOILD*wt+HEAT*wt+WATERL*wt+COOKL*wt+DRYERL*wt+ TALOAD*wt) * post audit indicator
STOCKPM	post CER participant indicator
TALOAD	other equipment capacity * index * hours
WATERL	water heat capacity * index * hours
WATERLL	water heat capacity * hours * index * laundry sector indicator
WATERLN	water heat capacity * decrease water heat number indicator
WATERLP	water heat capacity * increase water heat number indicator

A Durbin Watson statistic was calculated to assess whether serial correlation was present. The Durbin Watson statistic was .191 indicating the presence of serial correlation. Respondent-specific rho values were also calculated. The average rho value for the dataset is .883.

There also appeared to be significant heteroskedasticity present, based upon a review of the plot of residuals versus monthly therm use (page 4 of Appendix C). Evidence of serial correlation and heteroskedasticity led to the second stage estimation where a serial correlation correction was conducted.

Second Stage - Correction for Serial Correlation

The second stage was actually begun with the estimation of the respondent specific rho values. The predicted values from the initial conditional energy demand equation were used to estimate the level of correlation in the error term over time for each respondent (i.e.,

household). This was done by fitting an autoregressive model of order one, an AR(1) model, for each respondent.

The AR(1) model can be described as follows:

$$e_{i,t} = rho_i * e_{i,t-1} + \eta_{i,t}$$

where:

$e_{i,t}$ is the regression error term from the first stage for the i^{th} respondent in month t

$\eta_{i,t}$ is a "white noise" error term for the i^{th} respondent in month t

Estimates of rho_i, ρ_i, are obtained by regressing residuals from the first stage OLS model on the residuals values lagged one period. This is done separately for each respondent.

The estimated ρ_i values are used to transform the dependent variable and all the regressors. It is important to remember that each regressor in Table 7 has a time (t) and a customer(i) subscript attached to it. These subscripts were left out of the table for presentation purposes. For example, the STOCKPM variable in Table 7 should be interpreted as $(STOCKPM)_{i,t}$. The transformation involves replacing the value of $(STOCKPM)_{i,t}$ with the value of $(STOCKPM)_{i,t} - \rho_i * (STOCKPM)_{i,t-1}$.

Next the energy demand equation was reestimated using the transformed variables to correct for the correlation in the error term. This correction generates more consistent regression parameter estimates. The parameter estimates from this second stage are also summarized in Table 7. The detailed results are contained in Appendix C beginning on page 7. The adjusted R-squared is .581.

Third Stage - Correction for Heteroskedasticity

The third stage begins with a supplementary regression that serves two ends, it tests for the presence of heteroskedasticity and provides weights that can be used to correct for the heteroskedasticity that does exist. The supplementary regression takes the residuals computed from the second stage regression and estimates their squared value across customers as a function of: 1) the installed capacity of all equipment present in each business, 2) the type of business, and 3) the consumption size category segment to which

the customer belongs. The coefficients and t-values are provided below in Table 8. Note that the coefficient of STOCKTERM and the size segment terms have a significant t-values. This implies that heteroskedasticity is present, i.e. the variance of the error term is influenced by the magnitude of monthly consumption.

Table 8
Estimated Functional Form of Heteroskedasticity

Variable	Description	Coefficient	t-value
INTERCEPT	regression intercept	4828254	23.89
F_CND	Strata 1 indicator	-4713404	-21.50
F_CND2	Strata 2 . indicator	-4712911	-23.46
F_CND3	Strata 3 . indicator	-4650003	-23.00
F_CND4	Strata 4 . indicator	-4565321	-22.22
F_CND5	Strata 5. indicator	-4142721	-19.47
F_IND	Restaurant Sector indicator	-232959	-5.18
F_IND2	Lodging Sector indicator	-75012	-.88
F_IND3	Laundry Sector indicator	-188526	-2.84
F_IND4	Health Sector indicator	-77931	-.72
F_IND5	School Sector indicator	353048	3.39
F_PART	Audit participant indicator	30458	.81
STOCKTERM	Expected monthly usage based upon respondent-specific equipment holdings and estimated use per appliance from second stage results	.936	9.1
STOCKTERM*PART	Stock term *audit participation	.044	.5
STOCKTERM*CND	Stock term *usage strata 1	-2.52	-.33
STOCKTERM*CND2	Stock term *usage strata 2	-.7	-.66
STOCKTERM*CND3	Stock term *usage strata 3	-.36	-1.1
STOCKTERM*CND4	Stock term *usage strata 4	.28	5.4
STOCKTERM*CND5	Stock term *usage strata 5	-.178	-1.9
STOCKTERM*IND	Stock term *restaruant sector	-.66	-3.5
STOCKTERM*IND2	Stock term *lodging sector	-.50	-5.4
STOCKTERM*IND3	Stock term *laundry sector	-1.09	-9.7
STOCKTERM*IND4	Stock term *health sector	-.71	-2.1
STOCKTERM*IND5	Stock term *school sector	-.74	-7.2

Notes: Indicators are binary variables

The conditional demand model was then reestimated using the transformed values of the dependent and independent variables. The regression coefficients estimated in this third stage are both consistent and unbiased. They are shown in Table 7 , as well as in Appendix D.

While there is some loss of observations using this procedure more than 19,000 monthly observations were incorporated in the third stage regression model. The adjusted R-squared value from the third stage regression is .625.

The parameter estimates from this third stage model were used to calculate program impacts.

Appliance/Equipment Specific Gas Use Estimation

The boiler (gb), space heating (gsh), water heating (gwh), cooking (grg), clothes drying (gdy), and other (go) demand equations are explained in the remainder of this section.

Gas Boiler

The actual boiler load is based on customer behavior and the connected boiler load. The survey provided information regarding when boiler equipment was reduced or added in the last two years. The boiler usage model takes the form described below (the coefficient and t-values are provided in Table 7).

gb = 252.87 * BOILD

(t2) - 128.63 * BOILD *BCH_N

(t3) + 156.50 * BOILD *BCH_P

(t4) - 6.924 * BOILD*POST*AUDIT

where:

BOILD	boiler capacity
BOILD *BCH_N	boiler capacity * decrease boiler number indicator
BOILD *BCH_P	boiler capacity * increase boiler number indicator
BOILD*POST*AUDIT	boiler capacity * post audit period indicator * audit indicator

The first term captures the boiler use per Mmbtu of connected load. The coefficient has the expected sign which means that monthly use increases by almost 220 therms for each Mmbtu increase in boiler capacity. The next two terms (t2) and (t3) measure the impact of decreasing and increasing number of boiler units at the customer site. The month and year of the change is known, but the capacity amount is not known. The coefficient signs suggest that boiler use decreases as equipment pieces are reduced (t2) and increases when boiler units are added to the business(t3). Term (t4) is the impact per Mmbtu from the audit (wt for the boiler is 240 times the coefficient of -.028875).

Gas Space Heating

The actual space heating load is based on customer behavior and the principles of thermodynamics. Therm usage depends upon: 1) the efficiency of the heating system, 2) the thermal integrity of the building, 3) the area to be heated, and 4) the desired indoor temperature. The hours of operation, the production index, heating degree days, and the variables used to model the boiler (equipment capacity and changes in the number of pieces of equipment) were employed to model space heating use.

The space heating usage model takes the form described below (the coefficient and t-values are provided in Table 7).

gsh = 1.013667 * HEAT*HDD

(t2) + 1.732768 * SCAP*HOURS*INDEX

(t3) - 3.550974 * SCAP*HOURS*INDEX*SHCH_N

(t4) + 4.630804 * SCAP*HOURS*INDEX*SHCH_P

(t5) - .03176 * HEAT*POST*AUDIT

where:

HEAT*HDD	space heating capacity * HDD
SCAP*HOURS*INDEX	space heating capacity *hours of operation * production index
SCAP*HOURS*INDEX*SHCH_N	space ht capacity * hours of operation * production index * decrease space heat number indicator
SCAP*HOURS*INDEX*SHCH_P	space ht capacity * hours of operation * production index * increase space heat number indicator
HEAT*POST*AUDIT	space heating capacity * post audit indicator * * audit indicator

The first term captures the space heating load per degree day per Mmbtu of capacity. The coefficient has the expected positive sign, i.e., as degree days increase (as it becomes colder, on average) space heating energy use increases. The second term (t2) measures the influence operating hours and production have on space heating use. The positive sign suggests that as hours of operation and production rises, space heating use also rises. For the commercial sector production increases reflect such things as: more dryer use in the case of laundries, more meals served in the case of restaurants. Terms (t3) and (t4) represent the impact that changing the number of space heating equipment units has on usage. As is the case with boilers, decreasing the number of equipment units reduces energy load while increasing space heat equipment units increases usage. The last term (t5) evaluates the audit impact on space heating energy use. The coefficient for (t5) implies a .03 therm decrease per degree day of Mmbtu capacity after the audit.

Gas Water Heating

Gas water heating use is modeled as a function of the capacity of the water heater tank, the hours of operation, the production index, and the impact of the audit program effort. An incremental capacity term for water heating equipment in the laundry sector was added to account for additional water heating use beyond human comfort purposes. Laundry use in health facilities and education facilities doe not represent a large enough share of total use to warrant the inclusion of a separate water heating term for laundry use in these business sectors.

The water heating usage model takes the form (t-values reported in Table 7):

gwh = 2.85307 * WATERL*HOURS*INDEX

(t2) + 6.5608 * WATERL*HOURS*INDEX*LAUND

(t3) + .191224 * WATERL*HOURS*INDEX*WHCH_N

(t4) - 3.66481*WATERL*HOURS*INDEX*WHCH_P

(t5) - .0794 * WATERL*HOURS*INDEX*POST*AUDIT

where:

WATERL*HOURS*INDEX	water heat capacity * hours of operation indicator * production index
WATERL*HOURS*INDEX*LAUND	water heat capacity * hours * index * laundry sector indicator
WATERL*HOURS*INDEX*WHCH_N	water heat capacity * decrease water heat number indicator
WATERL*HOURS*INDEX*WHCH_P	water heat capacity * increase water heat number indicator
WATERL*HOURS*INDEX*POST* AUDIT	water heat capacity * hours of operation indicator * production index * post audit indicator * audit indicator

The first water heating term captures the impact that the interaction between capacity-weighted hours of operation and the production index has on water heating use. The positive coefficient indicates that as the capacity per hour of operation increases, water heating use increases. The Laundry sector term (t2) suggests that water heating use in laundries is more than twice as great as in the other five business sectors. Terms (t3) and (t4), the terms measuring equipment additions, have the opposite signs of what intuition would suggest, but neither of the terms are statistically significant. It may be that equipment additions are higher efficiency units that are used more intensively than lower capacity/efficiency units and that equipment removals tend to be older, lower efficiency units that result in use shifted to higher capacity/efficiency units. As the case with the boiler and space heater, term (t5) measures the influence the audit program has on water heating use.

Gas Cooking

Gas cooking use is modeled as a function of the capacity of the cooking equipment, the hours of operation, the production index, and the audit program efforts. An incremental

capacity term for cooking equipment in the Restaurant sector was added to account for the high volume of meals prepared in that sector.

The cooking usage model takes the form (t-values reported in Table 7):

grg = 7.73840 * COOKL*HOURS*INDEX

(t2) + 4.8215 * COOKL*HOURS*INDEX*REST

(t3) - 1.13110 *COOKL*HOURS*INDEX*CKCH_N

(t4) + 1.13201*COOKL*HOURS*INDEX*CKCH_P

(t5) - .231 * COOKL*HOURS*INDEX*POST*AUDIT

where:

COOKL*HOURS*INDEX	cooking capacity * hours of operation indicator * production index
COOKL*HOURS*INDEX*REST	cooking capacity * hours of operation indicator * production index * restaurant sector indicator
COOKL*HOURS*INDEX*CKCH_N	cooking capacity * hours of operation indicator * production index * decrease cooking number indicator
COOKL*HOURS*INDEX*CKCH_P	cooking capacity * hours of operation indicator * production index * increase cooking number indicator
COOKL*HOURS*INDEX*POST* AUDIT	cooking capacity * hours of operation * production index * post audit indicator * audit indicator

The first cooking term captures the impact that the interaction between capacity-weighted hours of operation and the production index for cooking use. The positive coefficient indicates that as the capacity per hour of operation increases, cooking use increases. The Restaurant sector term (t2) suggests that cooking use in restaurants is more than 50 percent greater than cooking use in the other business sectors. Terms (t3) and (t4), which relate to the addition and removal of equipment, have the expected signs. Term (t5) measures the influence the audit program has on cooking use. As expected, the coefficient has a negative sign, indicating energy use is, on average, reduced post-audit.

Gas Clothes Drying

Gas clothes drying use is modeled as a function of: 1) the capacity of the equipment, 2) the hours of operation, 3) the production index, and 4) the audit program efforts. An incremental capacity term for drying equipment in the Laundry sector was added to account for the extensive gas use devoted to clothes drying in that sector.

The drying usage model takes the form (t-values reported in Table 7):

gdy = 13.1280 * DRYERL*HOURS*INDEX

(t2) - 7.473 * DRYERL*HOURS*INDEX*LAUND

(t3) - 26495 * DRYERL*HOURS*INDEX*DYCH_N

(t4) - 3.6648 * DRYERL*HOURS*INDEX*DYCH_P

(t5) - 3898 * DRYERL*HOURS*INDEX*POST*AUDIT

where:

DRYERL*HOURS*INDEX	drying capacity * hours of operation indicator * production index
DRYERL*HOURS*INDEX*LAUND	drying capacity * hours of operation indicator * production index * laundry sector indicator
DRYERL*HOURS*INDEX*DYCH_N	drying capacity * hours of operation indicator * production index * decrease dryer number indicator
DRYERL*HOURS*INDEX*DYCH_P	drying capacity * hours of operation indicator * production index * increase dryer number indicator
DRYERL*HOURS*INDEX*POST* AUDIT	drying capacity * hours of operation * production index * post audit indicator * audit indicator

The first drying term captures the impact that the interaction between capacity-weighted hours of operation and the production index has on clothes drying use. The positive coefficient indicates as the capacity per hour of operation increases, clothes drying use increases. The Laundry sector term (t2) suggests that clothes drying use in laundries is just 35 percent as much as in the other sectors, suggesting that other sectors are able to obtain higher utilization rates on their dryers. This is not surprising since laundries must buy

sufficient equipment to serve peak demand times. Term (t3) has the expected sign, but (t4) has a negative, yet insignificant, sign as well. Term (t5) measures the impact the audit program has on clothes drying use; as expected, savings are indicated by the negative sign of the coefficient.

Other Gas Equipment

Although the most important commercial gas end-uses are discussed above, a variety of other gas-using equipment exists among SoCalGas commercial customers. Gas engines, kilns, non-laundry drying equipment, and process furnaces can be found, albeit in limited numbers, among "commercial" customers. There are insufficient numbers of such equipment types in the analytic data set to allow separate treatment. Consequently, other gas equipment use is modeled as a function of: 1) the capacity of the equipment, 2) the hours of operation, 3) the production index, and 4) the audit program efforts.

The other equipment usage model takes the form (t-values reported in Table 8):

go = 5.63867 * TALOAD*HOURS*INDEX

(t2) - .1733 * TALOAD*HOURS*INDEX*POST*AUDIT

where:

TALOAD*HOURS*INDEX	other equipment capacity * hours of operation * production index
TALOAD*HOURS*INDEX*POST*AUDIT	other equipment capacity * hours of operation * production index * post audit indicator * audit indicator

The first term captures the impact that the interaction between capacity hours of operation and the production index has on other equipment use. The positive coefficient indicates as the capacity per hour of operation increases, use rises. Term (t2) measures the influence the audit program has on other equipment use.

Therm Savings Impacts

This section of the report presents the saving impacts from the 1996 CEMS audit. It is organized as follows. First, the method used to estimate equipment usage and associated savings are discussed. Second, conservation savings estimates at the customer and program levels are presented.

Method of Calculating Equipment Therm Use

The energy use model regression coefficients displayed in Table 7 are employed to predict monthly consumption under normal weather condition values (heating degree days). Customers participating in the audit program had annual appliance energy use values calculated for the following scenarios:

a) no audit conducted

b) post audit (with saturation of gas-using equipment determined as sample-weighted averages from the analytic data set)

Customers in the comparison group had usage estimated assuming no audit was conducted in both scenarios. Monthly weather conditions, as well as other customer characteristics taken from the survey, are held constant throughout all the scenarios for all survey customers. The space heating usage estimates are based on average monthly weather conditions over the past 30 years in the Gas Company weather zones weighted for program participation. This approach permits the differences in appliance usage among the scenarios to truly reflect the therm savings attributed to the audit. Simulation results are presented in the next section.

Usage Savings Estimates

Equipment-specific annual energy savings associated with the 1996 CEMS audits are provided below. Table 9 displays the annual audit savings estimates for the six business groups and the total population on an end use specific basis. The ± therm savings that define the 90% and 80% confidence intervals are also included in the same table..

Table 9
CEMS Per Customer Annualized Therm Savings

End-Use	Restaurant	Lodging	Laundry	Health	Education	Other	Total
Boiler	51.0	48.0	30.0	569.0	166.0	82.0	73.0
90% CONF.	28.8	41.8	25.2	649.6	82.9	59.2	52.3
80% CONF.	22.4	32.6	19.6	506.3	64.6	46.2	40.8
Space Heat	11.0	21.0	15.0	34.0	52.0	28.0	21.0
90% CONF.	4.3	16.9	6.1	21.9	27.6	11.4	6.7
80% CONF.	3.3	13.2	4.7	17.1	21.5	8.8	5.3
Water Heat	6.0	53.0	9.0	38.0	8.0	7.0	11.0
90% CONF.	4.4	50.8	7.7	35.9	12.8	8.2	9.0
80% CONF.	3.5	39.6	6.0	27.9	10.0	6.4	7.1
Cooking	83.0	71.0	0.0	101.0	32.0	79.0	80.0
90% CONF.	63.8	86.2	0.0	101.3	28.8	67.0	65.0
80% CONF.	49.7	67.2	0.0	79.0	22.4	52.2	50.6
Dryer	57.0	120.0	347.0	152.0	16.0	42.0	195.0
90% CONF.	44.9	112.0	291.0	132.8	27.0	46.1	169.4
80% CONF.	35.0	87.3	226.8	103.5	21.0	35.9	132.0
Misc.	45.0	69.0	660.0	20.0	74.0	220.0	130.0
90% CONF.	29.3	118.1	345.6	9.9	61.7	4.4	51.2
80% CONF.	22.8	92.0	269.3	7.7	48.1	3.5	39.9
Overall	95.1	196.2	204.9	413.4	154.6	94.0	126.6
90% CONF.	70.4	192.6	170.6	425.5	100.9	61.9	95.9
80% CONF.	54.8	150.1	132.9	331.6	78.6	48.3	74.7

It should be noted that the 127 therm savings per audit is statistically significant at both the 80% and 90% levels. In fact all of the end use specific savings estimates are statistically different from zero. The only savings estimates that are not statistically different from zero are:

- Lodging facilities - cooking end use at the 90% level, miscellaneous end use at the 80% and 90% levels
- Health facilities - boiler end use at the 90% level, cooking end-use at the 90% level, and overall savings at the 90% level

- Education facilities - water heating end use at the 80% and 90% levels, dryer end use at the 80% and 90% levels

- Other facilities - water heat end use at the 90% level

Table 10 converts the per customer annualized therm savings of Table 9 into percentage savings of total use per customer. This is done by dividing the Table 10 "overall" values by the average usage values for each business group that are provided in the first row of Table 10..

Table 10
CEMS Per Customer Therm Savings Share of Annual Therm Use [a]

End-Use	Restaurant	Lodging	Laundry	Health	Education	Other	Total
Average Usage	8,101	14,052	11,770	23,380	10,623	9,925	10,143
90% Upper Confidence Bound	2.3%	2.8%	3.5%	3.5%	2.9%	1.9%	2.5%
80% Upper Confidence Bound	1.9%	2.5%	2.9%	3.2%	2.2%	1.4%	2.0%
Mean Savings	1.2%	1.4%	1.7%	1.8%	1.5%	0.9%	1.2%
80% Lower Confidence Bound	0.5%	0.3%	0.6%	0.3%	0.7%	0.5%	0.5%
90% Lower Confidence Bound	0.3%	0.0%	0.3%	-0.1%	0.5%	0.3%	0.3%

Notes: Average therm usage is somewhat overstated since audited customers whose use was less than 500 therms annually were not included, except in the case of restaurants.

Mean savings range from one to two percent of total use. This is consistent with the findings from the evaluation of the 1995 Industrial Energy Management Services Program.

Table 11 displays the annual audit savings at a program level for the six business groups and the total population. Estimated annual first year savings for the program was 2.1 million therms.

Table 11
1996 CEMS Program Annualized Therm Savings

End-Use	Restaurant	Lodging	Laundry	Health	Education	Other	Total
90% Upper Confidence Bound	1,406,725	344,120	820,182	326,568	197,571	1,027,676	4,247,430
80% Upper Confidence Bound	1,108,908	303,699	676,058	294,269	149,019	777,818	3,376,808
Total Savings	703,362	172,060	410,091	163,284	98,785	513,838	2,123,715
80% Lower Confidence Bound	297,817	40,421	144,125	32,298	48,552	249,858	870,623
90% Lower Confidence Bound	182,986	3,147	68,816	(4,790)	34,328	175,111	514,993

The program level ex-ante therm savings estimate is approximately one-fourth of the ex ante estimate. This is consistent with the per customer estimate of program savings.

Implications

The therm savings are lower than those employed previously and the savings estimates are statistically significant. Consideration should be given to lowering any future ex ante estimates of commercial audit savings to the levels provided above, if future program efforts are consistent in content and customer targeting with the 1996 CEMS Program.

Consideration should also be given to reducing the program life used in the annual cost effectiveness analysis. A reduction from 3 years to 2 years seems appropriate given the fact that the customer recollection of the SoCalGas audit and suggested actions was, for the most part, limited to less than one-fifth of the respondents (see Table 12).

Health care facilities, probably due to their size and the likelihood of an individual responsible for energy use, tended to have a higher likelihood of remembering the audit (and a higher average energy savings due to the audit). Overall, almost 70% of program participants who were willing to respond to the phone interview failed to recall having been audited by SoCalGas in 1996. It should be noted that the phone interview was conducted in the summer of 1997, hence the time period between the audit and the survey wan 6-18 months. It is also possible that the phone interviewer, in spite of explicit efforts, was not able to contact the individual actually present during the audit.

Table 12
Participant Recall of Audit and Audit Recommendations

N	Total	Restr.	Lodging	Laundry	Health	School	Other
Recall Audit/Recall Measure	72	20	7	11	8	10	16
Recall Audit/No Recall of Measure	108	21	9	22	11	19	26
Recalled Neither Audit Nor Measure	480	138	40	127	21	60	94
Total	660	179	56	160	40	89	136
%							
Recall Audit/Recall Measure	10.9%	11.2%	12.5%	6.9%	20.0%	11.2%	11.8%
Recall Audit/No Recall of Measure	16.4%	11.7%	16.1%	13.8%	27.5%	21.3%	19.1%
Recalled Neither Audit Nor Measure	72.7%	77.1%	71.4%	79.4%	52.5%	67.4%	69.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

APPENDIX A - 1996 COMMERCIAL ENERGY MANAGEMENT SERVICES PROGRAM PARTICIPANT AND NON-PARTICIPANT SURVEY QUESTIONNAIRE

THE GAS COMPANY
1996 Commercial Sector Audit Survey
(Participants)

May I please speak to **[CUSTOMER CONTACT NAME FROM SAMPLE]?**

[IF AVAILABLE, CONTINUE WITH S1. IF NOT, GO TO S2.]

S1. Hello, this is **[INTERVIEWER FIRST AND LAST NAME]**, calling on behalf of Southern California Gas Company. I am calling to discuss your experience with SoCalGas' 1996 Commercial Sector Audit Program. You should have received a letter from SoCalGas discussing our need to contact you.

Our records indicate that this facility had an energy audit performed by SoCalGas in 1996. Are you familiar with the 1996 SoCalGas Audit of your facility?

1.	Yes	**[CONTINUE]**
2.	No	**[ASK TO SPEAK TO THE PERSON WHO IS FAMILIAR WITH THE 1996 SOCALGAS AUDIT OF THE FACILITY AT THIS LOCATION]** If other person is unavailable, get name [and telephone number if different], and schedule a callback.
3.	Refused	**[TERMINATE]**

Briefly, this study is required by the California Public Utility Commission in order to assess our program efforts. We are charged with estimating the energy savings that result from our customer audits. We would like to briefly discuss the results of that audit with you. We would also like to obtain information that will allow us to estimate energy savings that may have resulted. Your answers will have no bearing on your current or future involvement with SoCalGas programs, and all of the information will be kept strictly confidential. Is now a good time for you? **[IF YES, CONTINUE WITH Q.1, IF NOT, SCHEDULE CALLBACK].**

S2. **[INTERVIEWER NOTE: IF CUSTOMER CONTACT FROM SAMPLE IS NOT AVAILABLE, THEN INDICATE YOU'RE CALLING ON BEHALF OF SOUTHERN CALIFORNIA GAS COMPANY AND ASK TO SPEAK WITH SOMEONE WHO IS FAMILIAR WITH THE 1996 SOCALGAS AUDIT OF THIS FACILITY. IF CONNECTED GO TO S3, IF NOT GET NAME AND TELEPHONE NUMBER AND SCHEDULE A CALLBACK]**

S3. AFTER YOU HAVE REACHED THE CORRECT INDIVIDUAL . . . SAY

Hello, this is **[INTERVIEWER FIRST AND LAST NAME]**, calling on behalf of Southern California Gas Company. I am calling to discuss your experience with SoCalGas' 1996 Commercial Audit Program. Our records indicate that this facility had an energy audit performed by SoCalGas in 1996.

Briefly, this study is required by the California Public Utility Commission in order to assess our program efforts. We are charged with estimating the energy savings that result from our customer audits. We would like to briefly discuss the results of that audit with you. We would also like to obtain information that will allow us to estimate energy savings that may have resulted. Your answers will have no bearing on your current or future involvement with SoCalGas programs, and all of the information will be kept strictly confidential. Is now a good time for you? **[IF YES, CONTINUE WITH Q.1, IF NO, SCHEDULE CALLBACK].**

1. Do you recall the 1996 SoCalGas audit?
   1 Yes
   2 No **[TERMINATE UNLESS SAMPLE/QUOTA EXHAUSTED; OTHER WISE SKIP TO Q.4]**

2. Approximately what date did the audit take place? **[RECORD VERBATIM.]**
   Month _____ Day _____

3. A. What energy conservation actions were suggested? **[USE CODING LIST TO RECORD; DO NOT READ]**
   B. Which pieces of natural-gas using equipment were affected by **[INSERT MEASURE, USE CODING LIST TO RECORD; DO NOT READ]**

[INTERVIEWER NOTE: REPEAT 3B-3G FOR EACH MEASURE]

   C. Was this measure adopted by your firm ? **[1=YES, 2=NO]** **[IF YES, ASK** When? **RECORD START DATE]**.
   D. Is the measure still in effect? **[1=YES, 2=NO]** **[IF NO, ASK** When was the measure discontinued? **RECORD STOP DATE]**.
   E. Would you have implemented the measure without the SoCal Gas audit? **[1=YES, 2=NO]**.
   F. Were you planning to implement the measure prior to receiving the SoCalGas energy audit? **[1=YES, 2=NO]**.
   G. Would you have implemented the measure at the same time if you had not received the SoCalGas energy audit? **[1=YES, 2=NO]** **[IF NO, ASK** When ? **RECORD DATE]**.

	3A Audit Measure	3B Affected Equip-ment	3C Adopted?		3D Discontinued ?		3E Would have Done W/O Audit? Y/N	3F Planned Prior to Audit? Y/N	3G Same time W/O Audit?	
			Y/N	Date	Y/N	Date			Y/N	Date
1										
2										
3										
4										
5										

[DO NOT READ TO PARTICIPANT] Coding List 3A - Audit Measures Recommended

Boilers
1=Frequent adjustment/cleaning of burners
2=Installation of steam/hot water pipe insulation or other components
3=Installation of condensate return lines where significant volumes exist
4=Installation of properly functioning steam trap
5=Installation of water softener and/or frequent removal of scale from heat exchange surfaces
6=Use of lowest temperature/pressure of hot water/steam that processes will allow
7=Installation of turbulators in firetubes to improve heat transfer
8=Preheat feedwater with waste heat (economizer or blowdown recovery)
9=Timers on hot water ciculating pumps
10=Space heating shut-off (or very low) after hours and days closed
11=Thermostats set low during heating season
12=Roof/ceiling insulation
13=Tight building shell with closed windows and doors and weatherstripping/caulking
14=Use of active solar space heating
Water Heating
15=Water heater temperature set as low as possible
16=Installation of flow restrictors where applicable
17=Installation of water heater blanket
18=Regularly clean heat exchanger surfaces (by delming and/or using water softener)
19=Shut circulating pumps off after hours, where applicable (closed loop systems)
20=Installation of hot water pipe insulation (especially for circulating, closed loop systems)
21=Call Gas Co. Customer Services for free burner calibration
Space Heaters
22=Thermostats set low during heating season
23=Space heating shut off or very low after hours and days closed; investigate timers
24=Turn pilots off in summer months or use IID's
25=Roof/ceiling/attic insulation
26=Tight building shell with closed windows and doors and weatherstripping/caulking
27=Existence of duct installation where ducts run through unconditioned areas
Air Conditioning
28=Thermostats set high
29=Equipment cut off after hours and days closed
30=Roof/ceiling/attic insulation
31=Tight building shell with closed windows and doors and weatherstripping/caulking
32=Insulated ducts in non-conditioned areas
33=Regular/automatic use of an economizer cycle

[DO NOT READ TO PARTICIPANT] Coding List 3A - Audit Measures Recommended

Cooking
34=Retrofit non-gas to gas equipment
35=Retrofit existing gas equipment to more energy efficient gas unit
36=Clean burners regularly
37=Better ventilation of residual heat
Clothes Drying
38=Retrofit non-gas to gas equipment
39=Retrofit existing gas equipment to more energy efficient gas unit
40=Better ventilation of residual heat
Pool Heaters
41=Thermostats set lower during heating season
42=Turn off during certain months/time-of-day
43=Retrofit non-gas to gas equipment
44=Retrofit existing gas equipment to more energy efficient gas heater

99=Other **[PLEASE RECORD VERBATIM DESCRIPTION]**

[DO NOT READ TO PARTICIPANT] Coding List 3B Equipment in Facility

1=Space heating
2=Space cooling
3=Water heating
4=Cooking equipment
5=Refrigeration equipment
6=Clothes drying equipment
7= Pool heater

8=Other natural gas using equipment **[PLEASE RECORD VERBATIM DESCRIPTION]**

4. **[INTERVIEWER READ]** SoCalGas also needs information on your firm's gas using equipment and on the historic use of that equipment. This information is needed in order to calculate estimates of energy savings that are not not related to production increases or equipment changes.

   A. Please indicate how many of the following pieces of natural gas using equipment you had in your facility during **1996. [READ LIST AND RECORD NUMBER OF UNITS.]**

   For each piece of equipment, ask what is the approximate:

   B. connected load (Mbtuh) and **[RECORD ANSWER]**

   C. utilization rate (%) **[RECORD ANSWER]**

Q4: EQUIPMENT IN FACILITY DURING 1996

		EQUIPMENT TYPES	Q4A RECORD # OF PIECES	Q4B CONNECTED LOAD Mbtuh	Q4C UTILZATION RATE (%)
1 11	_	PRIMARY SPACE HEATING EQUIPMENT [IF YES, AKS INFO BY TYEP]			
		_ BOILER (STEAM OR HOT WATER]			
		_ PACKAGED ROOFTOP UNIT			
		_ CENTRAL FURNACE			
		_ SPACE HEATERS			
		_ OTHER (SPECIFY]			
2 12	_	PRIMARY SPACE COOLING EQUIPMENT			
3 13	_	PRIMARY WATER HEATING EQUIPMENT [IF YES, ASK INFO BY TYPE]			
		_ CENTRAL BOILER (HEATING AND WATER HEATING]			
		_ INDIVIDUAL TANK (WATER HEATING ONLY]			
		_ WASTE HEAT RECOVERY			
4 17	_	COOKING EQUIPMENT [IF YES, ASK INFO BY TYPE]			
		_ OVENS			
		_ STOVES			
		_ GRILLS			
		_ BOILERS			
		_ FOOD WARNERS			
		_ STEAM TABLES			
		_ DEEP FRYERS			
5 18	_	CLOTHES DRYING EQUIPMENT			
6	_	REFRIGERATION EQUIPMENT			
7	_	SWIMMING POOL HEATERS			
8	_	DO YOU HAVE ANY OTHER MAJOR ENERGY-USING EQUIPMENT THAT I DIDN'T MENTION: [RECORD DESCRIPTION]	-	-	-
	_		-	-	-
	_	1.			
		2.			
		3.			

5. **[INTERVIEWER READ]** SoCalGas also needs to know if you have added or retired any equipment from 1/1/95 to the present.

A. Please indicate how many of the following pieces of natural gas using equipment that you added or retired between 1/1/95 and the present. **[READ LIST AND RECORD NUMBER OF UNITS.]**

For each piece of equipment:

B. check added or retired; if added, check if energy efficient **[RECORD ANSWERS]**

C. what was approximate change date **[RECORD MM/DD/YY]**

Q5: EQUIPMENT ADDED OR REPLACED IN FACILITY FROM **1/1/95 TO PRESENT**

	EQUIPMENT TYPES	Q5A RECORD # OF PIECES	Q5B CHANGE + MBTUH	Q5B CHANGE - MBTUH	Q5B CHANGE e	Q5C APPROX. CHANGE DATE
1	_ PRIMARY SPACE HEATING EQUIPMENT [IF YES, AKS INFO BY TYEP]					
	_ BOILER (STEAM OR HOT WATER]					
	_ PACKAGED ROOFTOP UNIT					
	_ CENTRAL FURNACE					
	_ SPACE HEATERS					
	_ OTHER (SPECIFY]					
2	_ PRIMARY SPACE COOLING EQUIPMENT					
12						
3	_ PRIMARY WATER HEATING EQUIPMENT [IF YES, ASK INFO Y TYPE]					
13						
	_ CENTRAL BOILER (HEATING AND WATER HEATING]					
	_ INDIVIDUAL TANK (WATER HEATING ONLY]					
	_ WASTE HEAT RECOVERY					
4	_ COOKING EQUIPMENT [IF YES, ASK INFO BY TYPE]					
17						
	_ OVENS					
	_ STOVES					
	_ GRILLS					
	_ BOILERS					
	_ FOOD WARNERS					
	_ STEAM TABLES					
	_ DEEP FRYERS					
5	_ CLOTHES DRYING EQUIPMENT					
18						
6	_ REFRIGERATION EQUIPMENT					
	_ SWIMMING POOL HEATERS					
7						
8	DO YOU HAVE ANY OTHER MAJOR ENERGY-USING EQUIPMENT THAT I DIDN'T MENTION: [RECORD DESCRIPTION]					
	1.	-	-			-
		-	-			
		-	-			-
	2.					-
	3.					

6. Next, I need to know your normal hours of operation at this location for each day of the week? **[INTERVIEWER READ LIST; ASK IF ANY CHANGES TO CURRENT HOURS BETWEEN 1/1/95 AND PRESENT. IF SO, GET APPROXIMATE DATE OF CHANGE]**

Current Hours	Any Changes 1/1/95 to Present	Approximate Change Date (MM/DD/YY)
(Example: 8:00 a.m. to 5:00 p.m.)		
_____ to _____ Monday	_____ to _____ Monday	_____
_____ to _____ Tuesday	_____ to _____ Tuesday	_____
_____ to _____ Wednsdy	_____ to _____ Wednesday	_____
_____ to _____ Thursday	_____ to _____ Thursday	_____
_____ to _____ Friday	_____ to _____ Friday	_____
_____ to _____ Saturday	_____ to _____ Saturday	_____
_____ to _____ Sunday	_____ to _____ Sunday	_____

7. Finally, we need an estimate of the monthly production from your facility. **[INTERVIEWER NOTE: IF DOMESTIC HOT WATER AND SPACE HEATING ARE MORE THAN 50% OF TOTAL MBUTH OF EXISTING EQUIPMENT, GO TO Q7C].** You may use any scale. For example, units produced, sales dollars or an index. Be assured that these data will be kept strictly confidential and will only be used to help distinguish audited-induced energy savings from energy use changes due to production shifts. First, can you provide me an estimate by individual piece of gas manufacturing equipment? **[IF YES, GO TO 7A. IF NO, GO TO 7B.]**

7A. Can you provide monthly data? **[IF YES, GO TO GRID 7AA. IF NO, GO TO GRID 7AB.]**

7AA. Tell me your total monthly production for **[ENTER TYPE FROM Q4A]** for each month in 1995, 1996 and so far in 1997. **[FILL MONTHLY GRID; REPEAT FOR EACH PIECE THAT PARTICIPANT HAS INFORMATION ON IN Q4A; UPON COMPLETION, GO TO CLOSING]**

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1995												
1996												
1997												

7AB. Can you provide it quarterly? **[IF NO, GO TO 7B, IF YES CONTINUE]** Tell me your total quarterly production for **[ENTER TYPE FROM Q4A]** for each quarter in 1995, 1996 and so far in 1997. **[FILL QUARTERLY GRID; REPEAT FOR EACH PIECE THAT PARTICIPANT HAS INFORMATION ON IN Q4A; UPON COMPLETION, GO TO CLOSING]**

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1995				
1996				
1997				

7B. Can you provide total facility monthly data? **[IF YES, GO TO GRID 7BA. IF NO, GO TO GRID 7BB.]**

7BA. Tell me your total monthly production for **[ENTER TYPE FROM Q4A]** for each month in 1995, 1996 and so far in 1997. **[FILL MONTHLY GRID; UPON COMPLETION, GO TO CLOSING]**

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1995												
1996												
1997												

7BB. Can you provide it quarterly? **[IF NO, GO TO 7C, IF YES CONTINUE]** Tell me your total quarterly production for each quarter in 1995, 1996 and so far in 1997. **[FILL QUARTERLY GRID; UPON COMPLETION, GO TO CLOSING]**

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1995				
1996				
1997				

7C. Can you provide total employment monthly data? **[IF YES, GO TO GRID 7CA. IF NO, GO TO GRID 7CB.]**

7CA. Tell me your total monthly employment for each month in 1995, 1996 and so far in 1997. **[FILL MONTHLY GRID; UPON COMPLETION, GO TO CLOSING]**

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1995												
1996												
1997												

7CB. Can you provide it quarterly? **[IF NO, GO TO 7D, IF YES CONTINUE]** Tell me your total quarterly employment for each quarter in 1995, 1996 and so far in 1997. **[FILL QUARTERLY GRID; UPON COMPLETION, GO TO CLOSING]**

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1995				
1996				
1997				

7D. Can you provide me with either total production and/or employment prior to the audit and after the audit? **[RECORD INFORMATION; GO TO CLOSING]**

	Total Production	Total Employment
Pre-Audit		
Post-Audit		

CLOSING; READ THE FOLLOWING: Thank you very much for the time and effort you gave in completing this interview. Your efforts will help SoCalGas to continue its industrial audit program.

[INTERVIEWER NOTE: INDICATE IF INTERVIEWER NOTES ATTACHED: 1=YES, 2=NO]

PLEASE ATTACH FOLLOWING FROM SAMPLE TO EACH COMPLETED SURVEY:

Customer Name
Account Number
Premise ID
Contact Name **Contact Phone Number**
SoCalGas Representative **Phone Number**
Survey ID

THE GAS COMPANY

1996 Commercial Sector Audit Survey
(Non-Participants)

May I please speak to **[CUSTOMER CONTACT NAME FROM SAMPLE]?**

[IF AVAILABLE, CONTINUE WITH S1. IF NOT, GO TO S2.]

S1. Hello, this is **[INTERVIEWER FIRST AND LAST NAME]**, calling on behalf of Southern California Gas Company. Briefly, this study is required by the California Public Utility Commission in order to assess our program efforts. We are charged with estimating the energy savings that result from our customer audits. Your company did not participate in the audit; however, we need to get some information from companies like yours who did not participate. This information will allow us to estimate energy savings that may have resulted from the audit program. Your answers will have no bearing on your current or future involvement with SoCalGas programs, and all of the information will be kept strictly confidential. Is now a good time for you? **[IF YES, CONTINUE WITH Q.1, IF NOT, SCHEDULE CALLBACK].**

S2. **[INTERVIEWER NOTE: IF CUSTOMER CONTACT FROM SAMPLE IS NOT AVAILABLE, THEN INDICATE YOU'RE CALLING ON BEHALF OF SOUTHERN CALIFORNIA GAS COMPANY AND ASK TO SPEAK WITH SOMEONE WHO IS FAMILIAR WITH THEIR COMPANIES OPERATIONS AND ENERGY USING EQUIPMENT. IF CONNECTED GO TO S3, IF NOT GET NAME AND TELEPHONE NUMBER AND SCHEDULE A CALLBACK]**

S3. **AFTER YOU HAVE REACHED THE CORRECT INDIVIDUAL . . . SAY**

Hello, this is **[INTERVIEWER FIRST AND LAST NAME]**, calling on behalf of Southern California Gas Company. Briefly, this study is required by the California Public Utility Commission in order to assess our program efforts. We are charged with estimating the energy savings that result from our customer audits. Your company did not participate in the audit; however, we need to get some information from companies like yours who did not participate. This information will allow us to estimate energy savings that may have resulted from the audit program. Your answers will have no bearing on your current or future involvement with SoCalGas programs, and all of the information will be kept strictly confidential. Is now a good time for you? **[IF YES, CONTINUE WITH Q.1, IF NOT, SCHEDULE CALLBACK].**

1. **[INTERVIEWER READ]** First, SoCalGas also needs information on your firm's gas using equipment and on the historic use of that equipment. This information is needed in order to calculate estimates of energy savings that are not not related to production increases or equipment changes.

A. Please indicate how many of the following pieces of natural gas using equipment you had in your facility during **1996. [READ LIST AND RECORD NUMBER OF UNITS.]**

For each piece of equipment, ask what is the approximate:

B. connected load (Mbtuh) and **[RECORD ANSWER]**

C. utilization rate (%) **[RECORD ANSWER]**

Q1: EQUIPMENT IN FACILITY DURING 1996

		EQUIPMENT TYPES	Q1A RECORD # OF PIECES	Q1B CONNECTED LOAD Mbtuh	Q1C UTILZATION RATE (%)
1	_	PRIMARY SPACE HEATING EQUIPMENT [IF YES, AKS INFO BY TYEP]			
11					
		_ BOILER (STEAM OR HOT WATER]			
		_ PACKAGED ROOFTOP UNIT			
		_ CENTRAL FURNACE			
		_ SPACE HEATERS			
		_ OTHER (SPECIFY]			
2	_	PRIMARY SPACE COOLING EQUIPMENT			
12					
3	_	PRIMARY WATER HEATING EQUIPMENT [IF YES, ASK INFO BY TYPE]			
13					
		_ CENTRAL BOILER (HEATING AND WATER HEATING]			
		_ INDIVIDUAL TANK (WATER HEATING ONLY]			
		_ WASTE HEAT RECOVERY			
4	_	COOKING EQUIPMENT [IF YES, ASK INFO BY TYPE]			
17					
		_ OVENS			
		_ STOVES			
		_ GRILLS			
		_ BOILERS			
		_ FOOD WARNERS			
		_ STEAM TABLES			
		_ DEEP FRYERS			
5	_	CLOTHES DRYING EQUIPMENT			
18					
6	_	REFRIGERATION EQUIPMENT			
	_	SWIMMING POOL HEATERS			
7					
8		DO YOU HAVE ANY OTHER MAJOR ENERGY-USING EQUIPMENT THAT I DIDN'T MENTION: [RECORD DESCRIPTION]			
	_		-	-	-
	_	1.	-	-	-
	_				
		2.			
		3.			

2. **[INTERVIEWER READ]** SoCalGas also needs to know if you have added or retired any equipment from 1/1/95 to the present.

A. Please indicate how many of the following pieces of natural gas using equipment you added or retired between 1/1/95 and the present. **[READ LIST AND RECORD NUMBER OF UNITS.]**

For each piece of equipment:

B. check added or retired; if added, check if energy efficient **[RECORD ANSWERS]**

C. what was approximate change date **[RECORD MM/DD/YY]**

Q2: EQUIPMENT ADDED OR REPLACED IN FACILITY FROM **1/1/95 TO PRESENT**

		EQUIPMENT TYPES	Q2A RECORD # OF PIECES	Q2B CHANGE + MBTUH	Q2B CHANGE - MBTUH	Q2B CHANGE e	Q2C APPROX. CHANGE DATE
1	_	PRIMARY SPACE HEATING EQUIPMENT [IF YES, AKS INFO BY TYEP]					
		_ BOILER (STEAM OR HOT WATER]					
		_ PACKAGED ROOFTOP UNIT					
		_ CENTRAL FURNACE					
		_ SPACE HEATERS					
		_ OTHER (SPECIFY]					
2 12	_	PRIMARY SPACE COOLING EQUIPMENT					
3 13	_	PRIMARY WATER HEATING EQUIPMENT [IF YES, ASK INFO Y TYPE]					
		_ CENTRAL BOILER (HEATING AND WATER HEATING]					
		_ INDIVIDUAL TANK (WATER HEATING ONLY]					
		_ WASTE HEAT RECOVERY					
4 17	_	COOKING EQUIPMENT [IF YES, ASK INFO BY TYPE]					
		_ OVENS					
		_ STOVES					
		_ GRILLS					
		_ BOILERS					
		_ FOOD WARNERS					
		_ STEAM TABLES					
		_ DEEP FRYERS					
5 18	_	CLOTHES DRYING EQUIPMENT					
6	_	REFRIGERATION EQUIPMENT					
7	_	SWIMMING POOL HEATERS					
8		DO YOU HAVE ANY OTHER MAJOR ENERGY-USING EQUIPMENT THAT I DIDN'T MENTION: [RECORD DESCRIPTION]					
	_						
	_	1_	-	-			-
	_		-	-			
		2_	-	-			-
							-
		3_					

3. Next, I need to know your normal hours of operation at this location for each day of the week? **[INTERVIEWER READ LIST; ASK IF ANY CHANGES TO CURRENT HOURS BETWEEN 1/1/95 AND PRESENT. IF SO, GET APPROXIMATE DATE OF CHANGE]**

Current Hours		Any Changes 1/1/95 to Present		Approximate Change Date (MM/DD/YY)
(Example: 8:00 a.m. to 5:00 p.m.)				
_____ to _____	Monday	_____ to _____	Monday	_____
_____ to _____	Tuesday	_____ to _____	Tuesday	_____
_____ to _____	Wednsdy	_____ to _____	Wednesday	_____
_____ to _____	Thursday	_____ to _____	Thursday	_____
_____ to _____	Friday	_____ to _____	Friday	_____
_____ to _____	Saturday	_____ to _____	Saturday	_____
_____ to _____	Sunday	_____ to _____	Sunday	_____

4. Finally, we need an estimate of the monthly production from your facility. **[INTERVIEWER NOTE: IF DOMESTIC HOT WATER AND SPACE HEATING ARE MORE THAN 50% OF TOTAL MBUTH OF EXISTING EQUIPMENT, GO TO Q4C].** You may use any scale. For example, units produced, sales dollars or an index. Be assured that these data will be kept strictly confidential and will only be used to help distinguish audited-induced energy savings from energy use changes due to production shifts. First, can you provide me an estimate by individual piece of gas manufacturing equipment? **[IF YES, GO TO 4A. IF NO, GO TO 4B.]**

4A. Can you provide monthly data? **[IF YES, GO TO GRID 7AA. IF NO, GO TO GRID 4AB.]**

4AA. Tell me your total monthly production for **[ENTER TYPE FROM Q1A]** for each month in 1995, 1996 and so far in 1997. **[FILL MONTHLY GRID; REPEAT FOR EACH PIECE THAT PARTICIPANT HAS INFORMATION ON IN Q4A; UPON COMPLETION, GO TO CLOSING]**

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1995												
1996												
1997												

4AB. Can you provide it quarterly? **[IF NO, GO TO 4B, IF YES CONTINUE]** Tell me your total quarterly production for **[ENTER TYPE FROM Q1A]** for each quarter in 1995, 1996 and so far in 1997. **[FILL QUARTERLY GRID; REPEAT FOR EACH PIECE THAT PARTICIPANT HAS INFORMATION ON IN Q1A; UPON COMPLETION, GO TO CLOSING]**

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1995				
1996				
1997				

4B. Can you provide total facility monthly data? **[IF YES, GO TO GRID 4BA. IF NO, GO TO GRID 4BB.]**

4BA. Tell me your total monthly production for **[ENTER TYPE FROM Q1A]** for each month in 1995, 1996 and so far in 1997. **[FILL MONTHLY GRID; UPON COMPLETION, GO TO CLOSING]**

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1995												
1996												
1997												

4BB. Can you provide it quarterly? **[IF NO, GO TO 4C, IF YES CONTINUE]** Tell me your total quarterly production for each quarter in 1995, 1996 and so far in 1997. **[FILL QUARTERLY GRID; UPON COMPLETION, GO TO CLOSING]**

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1995				
1996				
1997				

4C. Can you provide total employment monthly data? **[IF YES, GO TO GRID 4CA. IF NO, GO TO GRID 4CB.]**

4CA. Tell me your total monthly employment for each month in 1995, 1996 and so far in 1997. **[FILL MONTHLY GRID; UPON COMPLETION, GO TO CLOSING]**

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1995												
1996												
1997												

4CB. Can you provide it quarterly? **[IF NO, GO TO 7D, IF YES CONTINUE]** Tell me your total quarterly employment for each quarter in 1995, 1996 and so far in 1997. **[FILL QUARTERLY GRID; UPON COMPLETION, GO TO CLOSING]**

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1995				
1996				
1997				

4D. Can you provide me with either total production and/or employment prior to the audit and after the audit? **[RECORD INFORMATION; GO TO CLOSING]**

	Total Production	Total Employment
Pre-Audit		
Post-Audit		

CLOSING; READ THE FOLLOWING: Thank you very much for the time and effort you gave in completing this interview. Your efforts will help SoCalGas to continue its industrial audit program.

[INTERVIEWER NOTE: INDICATE IF INTERVIEWER NOTES ATTACHED: 1=YES, 2=NO]

PLEASE ATTACH FOLLOWING FROM SAMPLE TO EACH COMPLETED SURVEY:

Customer Name
Account Number
Premise ID
Contact Name **Contact Phone Number**
SoCalGas Representative **Phone Number**
Survey ID

APPENDIX B - VARIABLE STATISTICS AND CORRELATION MATRIX

Definitions of Variables

BCH_N	decrease boiler number indicator
BCH_P	increase boiler number indicator
BOIL	gas boiler indicator
BOILC	gas boiler capactiy (MMbtus per hour)
BOILD	boiler capacity
BOILLN	boiler capacity * decrease boiler number indicator
BOILLP	boiler capacity * increase boiler number indicator
CER	equipment replacement program indicator
CK	gas ccoking indicator
CKCH_N	decrease cooking number indicator
CKCH_P	increase cooking number indicator
COOKL	cooking capacity * index * hours
COOKLC	gas cooking capacity (MMbtus per hour)
COOKLN	cooking capacity * decrease cooking number indicator
COOKLP	cooking capacity * increase cooking number indicator
COOKLR	cooking cap * hours * index * restaurant sector indicator
DRYERL	drying capacity * index * hours
DRYERLL	drying capacity * hours * index * laundry sector indicator
DRYERLN	drying capacity * decrease dryer number indicator
DRYERLP	drying capacity * increase dryer number indicator
DY	gas drying indicator
DYC	gas drying capacity (MMbtus per hour)
DYCH_N	decrease clothes drying number indicator
DYCH_P	increase clothes drying number indicator
HDD	monthly heating degree days adjusted to a 30.4 day month
HEAT	space heating capacity * HDD
HOURS	weekly hours of operation
INDEX	production/business/employment index (base takes value of the series in January '95)
OT	other gas equipment indicator
SCAP	space heating capacity * index * hours
SCAPN	space ht capacity * decrease space heat number indicator
SCAPP	space ht capacity * increase space heat number indicator
SH	gas space heating indicator
SHC	space heating capacity (MMbtus per hour)
SHCH_N	decrease space heater number indicator

Definitions of Variables (continued)

SHCH_P	increase space heater number indicator
STOCKP	(BOILD*wt+HEAT*wt+WATERL*wt+COOKL* wt+DRYERL*wt+TALOAD*wt) * post audit indicator
STOCKPM	post CER participant indicator
TALOAD	other equipment capacity * index * hours
TALOADC	other gas equipment capacity (MMbtus per hour)
THERMS	monthly therms adjusted to a 30.4 day month
WATERL	water heat capacity * index * hours
WATERLL	water heat capacity * hours * index * laundry sector indicator
WATERLN	water heat capacity * decrease water heat number indicator
WATERLP	water heat capacity * increase water heat number indicator
WH	gas water heating indicator
WHC	gas water capacity (MMbtus per hour)
WHCH_N	decrease water heater number indicator
WHCH_P	increase water heater number indicator

Variable	N	Mean	Std Dev	Minimum	Maximum
THERMS	20505	845.2225917	1473.95	0.9212121	44211.73
SH	20505	0.5911000	0.4916308	0	1.0000000
BOIL	20505	0.1929964	0.3946502	0	1.0000000
WH	20505	0.7912863	0.4063893	0	1.0000000
CK	20505	0.6931866	0.4611712	0	1.0000000
DY	20505	0.1537126	0.3606730	0	1.0000000
OT	20505	0.0505012	0.2189768	0	1.0000000
HOURS	20162	89.5309614	38.5238685	28.0000000	168.0000000
INDEX	20077	1.0031032	0.0912648	0.1000000	3.9000000
HDD	20505	91.5331362	111.2451086	0	964.0000000
SHC	20505	0.2716843	0.7581711	0	25.0770000
BOILC	20505	0.3719536	3.4043475	0	108.5500000
TALOADC	20505	0.0698055	0.4678152	0	12.8830000
COOKLC	20505	0.3364675	0.3803906	0	5.0000000
DYC	20505	0.0840036	0.4638946	0	12.0000000
WHC	20505	0.1548816	0.3740812	0	8.8760000
DRYERLL	19909	5.8907053	46.6498501	0	962.1150000
WATERLL	19909	0.6487722	13.8927294	0	967.4840000
COOKLR	19909	22.8729901	32.6646540	0	528.1920000
BCH_N	20505	0.0019520	0.0441387	0	1.0000000
BCH_P	20505	0.0063046	0.0791509	0	1.0000000
SHCH_N	20505	0.0048445	0.0694337	0	1.0000000
SHCH_P	20505	0.0071494	0.0842511	0	1.0000000
WHCH_N	20505	0.0044687	0.0666991	0	1.0000000
WHCH_P	20505	0.0062147	0.0785882	0	1.0000000
DYCH_N	20505	0.000429175	0.0207121	0	1.0000000
DYCH_P	20505	0.0077185	0.0875151	0	1.0000000
CKCH_N	20505	0.0074095	0.0857590	0	1.0000000
CKCH_P	20505	0.0130820	0.1136258	0	1.0000000
BOILLN	20505	0.0043709	0.2975085	0	27.2000000
BOILLP	20505	0.0129796	0.4074312	0	27.2000000
SCAPN	19909	0.6784167	30.1202334	0	2332.16
SCAPP	19909	0.4025001	25.9355704	0	2332.16
DRYERLP	19909	0.0682743	3.5672481	0	316.2162162
DRYERLN	19909	0.0762883	4.8835452	0	322.5600000
WATERLN	19909	0.1673263	5.8622350	0	967.4840000
WATERLP	19909	0.2503049	6.4563673	0	967.4840000
COOKLP	19909	0.7190930	10.2722485	0	782.0400000
COOKLN	19909	0.4051846	5.3019459	0	91.0000000
HEAT	20505	26.5804631	119.2028733	0	8175.10
SCAP	19909	24.7651421	71.0557505	0	2332.16
TALOAD	19909	5.8191045	49.7501489	0	1134.00
BOILD	20505	0.3719536	3.4043475	0	108.5500000
WATERL	19909	16.9741409	55.0111259	0	967.4840000
STOCKP	19909	117.7107779	601.0571674	0	25064.16
STOCKPM	20505	0.0117281	0.1070442	0	1.0000000
COOKL	19909	32.5772274	46.8054566	0	797.8320000
DRYERL	19909	9.0270367	48.7098840	0	962.1150000

OBS	_TYPE_	_NAME_	THERMS	SH	BOIL	WH	CK	DY	OT	HOURS	INDEX	HDD	SHC
1	CORR	THERMS	1.00000	-0.02919	0.33661	-0.11045	-0.02926	0.21177	0.11587	0.19900	-0.00325	0.04734	0.35676
2	CORR	SH	-0.02919	1.00000	-0.29564	0.15845	0.12212	-0.15525	0.04135	-0.01710	-0.06982	0.05860	0.29804
3	CORR	BOIL	0.33661	-0.29564	1.00000	-0.38631	-0.38084	0.39158	0.02776	-0.03213	-0.03147	-0.02291	0.09699
4	CORR	WH	-0.11045	0.15845	-0.38631	1.00000	0.28441	-0.08946	-0.13547	-0.04501	-0.01740	0.01625	0.06341
5	CORR	CK	-0.02926	0.12212	-0.38084	0.28441	1.00000	-0.28126	-0.10150	0.14060	0.01449	-0.00311	0.02947
6	CORR	DY	0.21177	-0.15525	0.39158	-0.08946	-0.28126	1.00000	0.02266	0.23293	0.07659	0.01081	0.11995
7	CORR	OT	0.11587	0.04135	0.02776	-0.13547	-0.10150	0.02266	1.00000	-0.06547	-0.00254	0.01554	0.08804
8	CORR	HOURS	0.19900	-0.01710	-0.03213	-0.04501	0.14060	0.23293	-0.06547	1.00000	-0.00162	-0.02635	0.01982
9	CORR	INDEX	-0.00325	-0.06982	-0.03147	-0.01740	0.01449	0.07659	-0.00254	-0.00162	1.00000	0.00062	-0.04043
10	CORR	HDD	0.04734	0.05860	-0.02291	0.01625	-0.00311	0.01081	0.01554	-0.02635	0.00062	1.00000	0.02030
11	CORR	SHC	0.35676	0.29804	0.09699	0.06341	0.02947	0.11995	0.08804	0.01982	-0.04043	0.02030	1.00000

OBS	BOILC	TALOADC	COOKLC	DYC	WHC	DRYERLL	WATERLL	COOKLR	BCH_N	BCH_P	SHCH_N	SHCH_P	WHCH_N
1	0.23495	0.29691	0.30853	0.22675	0.25511	0.13637	0.07531	0.08818	0.12271	0.11777	0.02614	-0.00699	-0.00397
2	-0.05995	0.05677	0.04410	-0.13328	0.01772	-0.10995	-0.00797	0.06228	0.00091	-0.05247	0.04191	0.06354	0.05051
3	0.22342	0.06427	-0.12518	0.26175	0.05455	0.23013	0.07205	-0.26213	0.05247	0.12061	0.02172	-0.01922	0.02367
4	-0.09899	-0.05306	0.18368	-0.21040	0.21264	-0.21509	0.02427	0.18318	-0.00276	-0.07663	0.00710	0.02766	0.00968
5	-0.04999	-0.07628	0.56203	-0.21952	0.00472	-0.19272	-0.07127	0.45880	-0.05283	-0.08895	-0.00197	-0.08236	0.03859
6	0.06197	0.04281	-0.13110	0.42490	0.24895	0.29659	0.08155	-0.24876	0.03619	0.06447	-0.00102	-0.02997	0.06078
7	0.02134	0.28935	0.06179	0.02937	0.01998	-0.01916	-0.00716	0.03298	-0.01020	-0.01771	-0.00837	-0.01092	-0.01545
8	0.07886	-0.00972	0.13559	0.08834	0.23336	0.07609	0.00085	0.14834	0.04100	0.02162	0.03607	-0.05629	0.09209
9	-0.01207	-0.01006	-0.01089	-0.00453	-0.03459	0.00665	0.00471	0.07813	0.01498	0.00542	-0.02752	-0.00260	-0.02101
10	-0.00283	-0.00178	-0.02597	-0.00396	0.00989	-0.01054	0.00136	-0.02906	-0.01702	-0.01853	-0.02014	-0.00867	-0.01914
11	0.09012	0.30255	0.14746	-0.01906	0.23061	-0.03777	0.05303	-0.07344	-0.00770	0.01894	0.16766	0.08313	0.01028

OBS	WHCH_P	DYCH_N	DYCH_P	CKCH_N	CKCH_P	BOILLN	BOILLP	SCAPN	SCAPP	DRYERLP	DRYERLN	WATERLN	WATERLP
1	0.01051	0.00717	-0.00389	0.01469	0.01247	0.09477	0.15866	0.11764	0.11672	0.12239	0.00425	0.02644	0.02531
2	0.02319	-0.02491	-0.10353	-0.03686	-0.04992	-0.01218	-0.00554	0.01843	0.01270	-0.00429	-0.01909	0.02320	0.00688
3	0.05133	0.03800	-0.02673	-0.02620	-0.03683	0.03004	0.06514	0.04313	0.02219	0.03249	0.03089	0.04000	0.06014
4	0.00869	-0.03610	0.03875	0.01879	0.04754	-0.02080	-0.01871	0.01036	0.00651	-0.01293	-0.02930	0.01483	0.02015
5	0.01934	-0.02741	-0.10986	0.03798	0.06868	-0.01954	-0.04318	0.01472	0.00384	-0.01895	-0.02317	0.01358	-0.00535
6	0.07586	0.03189	-0.01103	-0.02615	-0.03793	-0.00448	-0.00111	0.04858	0.02447	0.04495	0.03669	0.01006	0.03685
7	-0.01824	-0.00478	-0.02034	-0.01993	-0.02655	-0.00339	-0.00587	0.03740	0.04631	-0.00451	-0.00368	-0.00673	-0.00914
8	0.10080	0.00622	0.01305	0.02367	0.04837	0.01191	-0.00549	0.00402	-0.00149	0.01012	0.00911	0.04508	0.06495
9	0.00127	0.00269	0.04055	0.00215	0.00023	-0.00006	-0.00115	-0.01308	-0.00053	-0.00087	-0.00024	-0.00281	0.01297
10	-0.02379	-0.00901	-0.01822	-0.02733	-0.03043	-0.00329	-0.00531	-0.00045	-0.00267	-0.00725	-0.00144	-0.00739	-0.01075
11	0.01138	-0.00743	-0.03127	-0.00634	-0.02404	-0.00381	0.06921	0.42464	0.36074	-0.00430	-0.00556	0.02972	0.02257

OBS	COOKLP	COOKLN	HEAT	SCAP	TALOAD	BOILD	WATERL	STOCKP	STOCKPM	COOKL	DRYERL
1	0.07323	0.03179	0.34632	0.33207	0.30756	0.23495	0.22738	0.14772	0.04781	0.36284	0.22613
2	-0.00991	-0.03847	0.18546	0.28519	0.04494	-0.05995	-0.02763	-0.06086	0.04726	-0.00090	-0.13856
3	-0.02244	-0.02709	0.06779	0.07741	0.08240	0.22342	0.04685	0.10269	0.03408	-0.05062	0.28683
4	0.03108	0.02944	0.03592	0.06071	-0.05851	-0.09899	0.16036	-0.05841	0.00574	0.08309	-0.22101
5	0.04587	0.05007	0.01132	0.03591	-0.05489	-0.04999	-0.01110	-0.00198	0.07174	0.43452	-0.20680
6	-0.01763	-0.02305	0.07642	0.15203	0.06972	0.06197	0.26480	0.11670	0.01000	-0.03433	0.43528
7	-0.01650	-0.01801	0.05563	0.10141	0.25300	0.02134	0.02009	-0.00056	0.01389	0.08715	0.02216
8	0.05089	0.02853	0.00654	0.21227	0.06381	0.07886	0.33502	0.10730	0.08947	0.32438	0.17498
9	0.00153	0.00319	-0.00680	-0.00865	-0.00437	-0.01207	-0.00449	0.04353	-0.00651	0.04983	0.00921
10	-0.02233	-0.02456	0.29814	0.02050	-0.00854	-0.00283	0.00220	-0.02709	-0.00819	-0.02485	-0.01287
11	-0.00819	-0.00861	0.63473	0.88390	0.28107	0.09012	0.12923	-0.00019	0.05199	0.10670	-0.01933

OBS	_TYPE_	_NAME_	THERMS	SH	BOIL	WH	CK	DY	OT	HOURS	INDEX	HDD	SHC
12	CORR	BOILC	0.23495	-0.05995	0.22342	-0.09899	-0.04999	0.06197	0.02134	0.07886	-0.01207	-0.00283	0.09012
13	CORR	TALOADC	0.29691	0.05677	0.06427	-0.05306	-0.07628	0.04281	0.28935	-0.00972	-0.01006	-0.00178	0.30255
14	CORR	COOKLC	0.30853	0.04410	-0.12518	0.18368	0.56203	-0.13110	0.06179	0.13559	-0.01089	-0.02597	0.14746
15	CORR	DYC	0.22675	-0.13328	0.26175	-0.21040	-0.21952	0.42490	0.02937	0.08834	-0.00453	-0.00396	-0.01906
16	CORR	WHC	0.25511	0.01772	0.05455	0.21264	0.00472	0.24895	0.01998	0.23336	-0.03459	0.00989	0.23061
17	CORR	DRYERLL	0.13637	-0.10995	0.23013	-0.21509	-0.19272	0.29659	-0.01916	0.07609	0.00665	-0.01054	-0.03777
18	CORR	WATERLL	0.07531	-0.00797	0.07205	0.02427	-0.07127	0.08155	-0.00716	0.00085	0.00471	0.00136	0.05303
19	CORR	COOKLR	0.08818	0.06228	-0.26213	0.18318	0.45880	-0.24876	0.03298	0.14834	0.07813	-0.02906	-0.07344
20	CORR	BCH_N	0.12271	0.00091	0.05247	-0.00276	-0.05283	0.03619	-0.01020	0.04100	0.01498	-0.01702	-0.00770
21	CORR	BCH_P	0.11777	-0.05247	0.12061	-0.07663	-0.08895	0.06447	-0.01771	0.02162	0.00542	-0.01853	0.01894
22	CORR	SHCH_N	0.02614	0.04191	0.02172	0.00710	-0.00197	-0.00102	-0.00837	0.03607	-0.02752	-0.02014	0.16766

OBS	BOILC	TALOADC	COOKLC	DYC	WHC	DRYERLL	WATERLL	COOKLR	BCH_N	BCH_P	SHCH_N	SHCH_P	WHCH_N
12	1.00000	0.02917	0.03642	0.05505	0.03064	0.03128	0.00173	-0.05572	0.02426	0.03947	0.02112	-0.00223	0.00787
13	0.02917	1.00000	0.04638	0.00158	0.05183	-0.01309	0.00013	-0.07557	0.11545	0.05844	0.02600	0.00188	0.00055
14	0.03642	0.04638	1.00000	-0.10415	0.10604	-0.11237	-0.04156	0.63497	-0.01520	-0.03951	0.00975	-0.05138	0.01702
15	0.05505	0.00158	-0.10415	1.00000	0.03602	0.89867	0.03413	-0.11204	-0.00118	0.04541	-0.00849	-0.00903	-0.00695
16	0.03064	0.05183	0.10604	0.03602	1.00000	-0.03543	0.31990	-0.07870	0.05783	0.09792	0.00383	-0.00114	0.01691
17	0.03128	-0.01309	-0.11237	0.89867	-0.03543	1.00000	0.03911	-0.08842	-0.00472	0.03380	-0.00750	-0.00682	-0.00840
18	0.00173	0.00013	-0.04156	0.03413	0.31990	0.03911	1.00000	-0.03270	-0.00212	-0.00372	-0.00200	-0.00346	0.01131
19	-0.05572	-0.07557	0.63497	-0.11204	-0.07870	-0.08842	-0.03270	1.00000	-0.02732	-0.05332	0.01049	-0.02400	0.00105
20	0.02426	0.11545	-0.01520	-0.00118	0.05783	-0.00472	-0.00212	-0.02732	1.00000	0.55312	-0.00309	-0.00178	0.02900
21	0.03947	0.05844	-0.03951	0.04541	0.09792	0.03380	-0.00372	-0.05332	0.55312	1.00000	0.04619	0.03760	0.01249
22	0.02112	0.02600	0.00975	-0.00849	0.00383	-0.00750	-0.00200	0.01049	-0.00309	0.04619	1.00000	0.50056	0.05161

OBS	WHCH_P	DYCH_N	DYCH_P	CKCH_N	CKCH_P	BOILLN	BOILLP	SCAPN	SCAPP	DRYERLP	DRYERLN	WATERLN	WATERLP
12	0.00761	0.00285	-0.00120	-0.00804	-0.01063	0.08580	0.11632	0.05423	0.03339	0.03205	0.00241	0.02162	0.01997
13	-0.00285	-0.00309	-0.01315	-0.01289	0.01287	0.00867	0.00517	0.10420	0.10737	-0.00268	-0.00220	0.01673	0.01337
14	0.00934	-0.01679	-0.05403	0.04783	0.07246	-0.00793	-0.02272	0.03258	0.00719	-0.00462	-0.01363	0.03582	0.02359
15	-0.00369	0.06398	0.00460	-0.01408	-0.01707	-0.00252	0.00571	0.01203	0.01399	0.12396	0.09068	-0.00274	0.00372
16	0.02105	0.01250	0.12677	0.04719	0.03218	-0.00002	0.02071	0.07039	0.07980	0.04959	-0.00256	0.11030	0.11208
17	-0.00976	0.07287	-0.00343	-0.01118	-0.01295	-0.00180	0.00423	-0.00284	-0.00154	0.05787	0.10247	-0.00348	-0.00478
18	0.00891	-0.00099	-0.00391	-0.00413	-0.00479	-0.00070	-0.00151	-0.00105	-0.00070	-0.00089	-0.00073	0.15705	0.14200
19	-0.00303	-0.01486	-0.06328	0.05022	0.09270	-0.01054	-0.02266	-0.01328	-0.00824	-0.01340	-0.01094	-0.01726	-0.02243
20	0.02363	-0.00092	-0.00390	0.01764	0.01111	0.33220	0.24118	-0.00102	-0.00070	-0.00087	-0.00071	0.09177	0.08274
21	0.05454	-0.00165	0.05634	0.00509	0.02249	0.18410	0.39995	-0.00180	-0.00102	0.02476	-0.00125	0.05083	0.04513
22	0.09437	-0.00145	-0.00615	0.03149	0.02029	-0.00103	0.00175	0.37944	0.21239	-0.00114	-0.00093	-0.00169	-0.00230

OBS	COOKLP	COOKLN	HEAT	SCAP	TALOAD	BOILD	WATERL	STOCKP	STOCKPM	COOKL	DRYERL
12	-0.00510	-0.00758	0.06511	0.07477	0.03617	1.00000	0.02526	0.29838	0.00943	0.06195	0.05650
13	-0.00906	-0.01078	0.17438	0.31258	0.92229	0.02917	0.03641	0.00731	0.00901	0.06398	0.00825
14	0.13646	0.06931	0.08558	0.15577	0.08611	0.03642	0.07984	0.11738	0.09035	0.90117	-0.08072
15	-0.00103	-0.01183	-0.01115	-0.00959	0.01365	0.05505	0.03721	0.25607	-0.01215	-0.05173	0.92126
16	0.04742	0.07380	0.15363	0.23464	0.06474	0.03064	0.95584	0.04991	0.03931	0.14201	0.05390
17	-0.00884	-0.00965	-0.02345	-0.03771	-0.00953	0.03128	-0.02760	0.23226	-0.01418	-0.08789	0.94958
18	-0.00327	-0.00357	0.03122	0.06492	-0.00157	0.00173	0.23869	0.03566	-0.00524	-0.03250	0.03445
19	0.06959	0.07418	-0.04700	-0.03358	-0.05378	-0.05572	-0.07817	0.10053	0.12080	0.55270	-0.11023
20	0.01084	0.02368	-0.00678	-0.00484	0.15226	0.02426	0.07268	0.01466	0.01235	-0.00752	0.00240
21	0.00241	0.00940	0.00681	0.00695	0.08204	0.03947	0.11764	0.01062	0.00990	-0.02481	0.03496
22	0.01966	0.04160	0.07524	0.14072	0.02417	0.02112	-0.00137	0.01657	-0.00764	0.03293	-0.00696

OBS	_TYPE_	_NAME_	THERMS	SH	BOIL	WH	CK	DY	OT	HOURS	INDEX	HDD	SHC
23	CORR	SHCH_P	-0.00699	0.06354	-0.01922	0.02766	-0.08236	-0.02997	-0.01092	-0.05629	-0.00260	-0.00867	0.08313
24	CORR	WHCH_N	-0.00397	0.05051	0.02367	0.00968	0.03859	0.06078	-0.01545	0.09209	-0.02101	-0.01914	0.01028
25	CORR	WHCH_P	0.01051	0.02319	0.05133	0.00869	0.01934	0.07586	-0.01824	0.10080	0.00127	-0.02379	0.01138
26	CORR	DYCH_N	0.00717	-0.02491	0.03800	-0.03610	-0.02741	0.03189	-0.00478	0.00622	0.00269	-0.00901	-0.00743
27	CORR	DYCH_P	-0.00389	-0.10353	-0.02673	0.03875	-0.10986	-0.01103	-0.02034	0.01305	0.04055	-0.01822	-0.03127
28	CORR	CKCH_N	0.01469	-0.03686	-0.02620	0.01879	0.03798	-0.02615	-0.01993	0.02367	0.00215	-0.02733	-0.00634
29	CORR	CKCH_P	0.01247	-0.04992	-0.03683	0.04754	0.06868	-0.03793	-0.02655	0.04837	0.00023	-0.03043	-0.02404
30	CORR	BOILLN	0.09477	-0.01218	0.03004	-0.02080	-0.01954	-0.00448	-0.00339	0.01191	-0.00006	-0.00329	-0.00381
31	CORR	BOILLP	0.15866	-0.00554	0.06514	-0.01871	-0.04318	-0.00111	-0.00587	-0.00549	-0.00115	-0.00531	0.06921
32	CORR	SCAPN	0.11764	0.01843	0.04313	0.01036	0.01472	0.04858	0.03740	0.00402	-0.01308	-0.00045	0.42464
33	CORR	SCAPP	0.11672	0.01270	0.02219	0.00651	0.00384	0.02447	0.04631	-0.00149	-0.00053	-0.00267	0.36074

OBS	BOILC	TALOADC	COOKLC	DYC	WHC	DRYERLL	WATERLL	COOKLR	BCH_N	BCH_P	SHCH_N	SHCH_P	WHCH_N
23	-0.00223	0.00188	-0.05138	-0.00903	-0.00114	-0.00682	-0.00346	-0.02400	-0.00178	0.03760	0.50056	1.00000	0.04070
24	0.00787	0.00055	0.01702	-0.00695	0.01691	-0.00840	0.01131	0.00105	0.02900	0.01249	0.05161	0.04070	1.00000
25	0.00761	-0.00285	0.00934	-0.00369	0.02105	-0.00976	0.00891	-0.00303	0.02363	0.05454	0.09437	0.07561	0.84723
26	0.00285	-0.00309	-0.01679	0.06398	0.01250	0.07287	-0.00099	-0.01486	-0.00092	-0.00165	-0.00145	-0.00176	-0.00139
27	-0.00120	-0.01315	-0.05403	0.00460	0.12677	-0.00343	-0.00391	-0.06328	-0.00390	0.05634	-0.00615	-0.00748	-0.00591
28	-0.00804	-0.01289	0.04783	-0.01408	0.04719	-0.01118	-0.00413	0.05022	0.01764	0.00509	0.03149	0.02359	0.03327
29	-0.01063	0.01287	0.07246	-0.01707	0.03218	-0.01295	-0.00479	0.09270	0.01111	0.02249	0.02029	0.01357	0.02177
30	0.08580	0.00867	-0.00793	-0.00252	-0.00002	-0.00180	-0.00070	-0.01054	0.33220	0.18410	-0.00103	-0.00092	0.00868
31	0.11632	0.00517	-0.02272	0.00571	0.02071	0.00423	-0.00151	-0.02266	0.24118	0.39995	0.00175	0.00247	0.00493
32	0.05423	0.10420	0.03258	0.01203	0.07039	-0.00284	-0.00105	-0.01328	-0.00102	-0.00180	0.37944	0.13977	0.00650
33	0.03339	0.10737	0.00719	0.01399	0.07980	-0.00154	-0.00070	-0.00824	-0.00070	-0.00102	0.21239	0.20093	0.00827

OBS	WHCH_P	DYCH_N	DYCH_P	CKCH_N	CKCH_P	BOILLN	BOILLP	SCAPN	SCAPP	DRYERLP	DRYERLN	WATERLN	WATERLP
23	0.07561	-0.00176	-0.00748	0.02359	0.01357	-0.00092	0.00247	0.13977	0.20093	-0.00148	-0.00121	-0.00220	-0.00299
24	0.84723	-0.00139	-0.00591	0.03327	0.02177	0.00868	0.00493	0.00650	0.00827	-0.00131	-0.00107	0.41582	0.37667
25	1.00000	-0.00164	-0.00697	0.02632	0.01592	0.00704	0.00698	0.00520	0.00689	-0.00151	-0.00124	0.36068	0.48989
26	-0.00164	1.00000	0.08683	-0.00179	-0.00239	-0.00030	-0.00066	-0.00048	-0.00033	0.01956	0.73591	-0.00061	-0.00082
27	-0.00697	0.08683	1.00000	-0.00762	-0.01015	-0.00130	-0.00281	-0.00204	-0.00140	0.21179	0.00204	-0.00258	-0.00350
28	0.02632	-0.00179	-0.00762	1.00000	0.63029	-0.00127	-0.00275	0.00337	0.00485	-0.00169	-0.00138	-0.00253	-0.00343
29	0.01592	-0.00239	-0.01015	0.63029	1.00000	-0.00169	-0.00191	0.00233	0.00380	-0.00196	-0.00160	-0.00293	-0.00398
30	0.00704	-0.00030	-0.00130	-0.00127	-0.00169	1.00000	0.72982	-0.00034	-0.00023	-0.00029	-0.00024	0.02772	0.02498
31	0.00698	-0.00066	-0.00281	-0.00275	-0.00191	0.72982	1.00000	-0.00073	-0.00027	-0.00062	-0.00051	0.01964	0.01741
32	0.00520	-0.00048	-0.00204	0.00337	0.00233	-0.00034	-0.00073	1.00000	0.85920	-0.00043	-0.00035	-0.00064	-0.00087
33	0.00689	-0.00033	-0.00140	0.00485	0.00380	-0.00023	-0.00027	0.85920	1.00000	-0.00030	-0.00024	-0.00044	-0.00060

OBS	COOKLP	COOKLN	HEAT	SCAP	TALOAD	BOILD	WATERL	STOCKP	STOCKPM	COOKL	DRYERL
23	0.01294	0.02964	0.03493	0.04686	0.00554	-0.00223	-0.00940	0.00264	-0.00930	-0.03039	-0.00940
24	0.01581	0.03470	-0.00019	0.03224	0.00904	0.00787	0.02334	0.03743	-0.00734	0.03647	-0.00488
25	0.01237	0.02865	0.00316	0.02715	0.00557	0.00761	0.03344	0.04283	-0.00866	0.02489	0.00366
26	-0.00149	-0.00162	-0.00462	-0.00740	-0.00248	0.00285	0.01811	0.08830	-0.00227	-0.01262	0.06988
27	-0.00633	-0.00691	-0.01953	-0.03131	-0.01056	-0.00120	0.13564	-0.00721	-0.00062	-0.02995	-0.00111
28	0.42317	0.86327	-0.01137	0.00343	-0.01035	-0.00804	0.04010	0.02611	0.19977	0.03694	-0.01330
29	0.68245	0.71199	-0.01967	-0.00603	-0.01140	-0.01063	0.04528	0.05260	0.10546	0.07996	-0.01150
30	-0.00105	-0.00115	-0.00264	-0.00391	0.01226	0.08580	0.00016	0.00210	-0.00161	-0.00502	-0.00270
31	-0.00227	-0.00247	0.03627	0.04184	0.00791	0.11632	0.00597	0.00295	0.00440	-0.01795	0.00206
32	0.00125	0.00376	0.21911	0.41626	0.09223	0.05423	0.04336	-0.00296	-0.00253	0.02294	0.00996
33	0.00220	0.00518	0.16156	0.35968	0.09582	0.03339	0.04975	-0.00134	-0.00174	0.00567	0.01182

OBS	_TYPE_	_NAME_	THERMS	SH	BOIL	WH	CK	DY	OT	HOURS	INDEX	HDD	SHC
34	CORR	DRYERLP	0.12239	-0.00429	0.03249	-0.01293	-0.01895	0.04495	-0.00451	0.01012	-0.00087	-0.00725	-0.00430
35	CORR	DRYERLN	0.00425	-0.01909	0.03089	-0.02930	-0.02317	0.03669	-0.00368	0.00911	-0.00024	-0.00144	-0.00556
36	CORR	WATERLN	0.02644	0.02320	0.04000	0.01483	0.01358	0.01006	-0.00673	0.04508	-0.00281	-0.00739	0.02972
37	CORR	WATERLP	0.02531	0.00688	0.06014	0.02015	-0.00535	0.03685	-0.00914	0.06495	0.01297	-0.01075	0.02257
38	CORR	COOKLP	0.07323	-0.00991	-0.02244	0.03108	0.04587	-0.01763	-0.01650	0.05089	0.00153	-0.02233	-0.00819
39	CORR	COOKLN	0.03179	-0.03847	-0.02709	0.02944	0.05007	-0.02305	-0.01801	0.02853	0.00319	-0.02456	-0.00861
40	CORR	HEAT	0.34632	0.18546	0.06779	0.03592	0.01132	0.07642	0.05563	0.00654	-0.00680	0.29814	0.63473
41	CORR	SCAP	0.33207	0.28519	0.07741	0.06071	0.03591	0.15203	0.10141	0.21227	-0.00865	0.02050	0.88390
42	CORR	TALOAD	0.30756	0.04494	0.08240	-0.05851	-0.05489	0.06972	0.25300	0.06381	-0.00437	-0.00854	0.28107
43	CORR	BOILD	0.23495	-0.05995	0.22342	-0.09899	-0.04999	0.06197	0.02134	0.07886	-0.01207	-0.00283	0.09012
44	CORR	WATERL	0.22738	-0.02763	0.04685	0.16036	-0.01110	0.26480	0.02009	0.33502	-0.00449	0.00220	0.12923

OBS	BOILC	TALOADC	COOKLC	DYC	WHC	DRYERLL	WATERLL	COOKLR	BCH_N	BCH_P	SHCH_N	SHCH_P	WHCH_N
34	0.03205	-0.00268	-0.00462	0.12396	0.04959	0.05787	-0.00089	-0.01340	-0.00087	0.02476	-0.00114	-0.00148	-0.00131
35	0.00241	-0.00220	-0.01363	0.09068	-0.00256	0.10247	-0.00073	-0.01094	-0.00071	-0.00125	-0.00093	-0.00121	-0.00107
36	0.02162	0.01673	0.03582	-0.00274	0.11030	-0.00348	0.15705	-0.01726	0.09177	0.05083	-0.00169	-0.00220	0.41582
37	0.01997	0.01337	0.02359	0.00372	0.11208	-0.00478	0.14200	-0.02243	0.08274	0.04513	-0.00230	-0.00299	0.37667
38	-0.00510	-0.00906	0.13646	-0.00103	0.04742	-0.00884	-0.00327	0.06959	0.01084	0.00241	0.01966	0.01294	0.01581
39	-0.00758	-0.01078	0.06931	-0.01183	0.07380	-0.00965	-0.00357	0.07418	0.02368	0.00940	0.04160	0.02964	0.03470
40	0.06511	0.17438	0.08558	-0.01115	0.15363	-0.02345	0.03122	-0.04700	-0.00678	0.00681	0.07524	0.03493	-0.00019
41	0.07477	0.31258	0.15577	-0.00959	0.23464	-0.03771	0.06492	-0.03358	-0.00484	0.00695	0.14072	0.04686	0.03224
42	0.03617	0.92229	0.08611	0.01365	0.06474	-0.00953	-0.00157	-0.05378	0.15226	0.08204	0.02417	0.00554	0.00904
43	1.00000	0.02917	0.03642	0.05505	0.03064	0.03128	0.00173	-0.05572	0.02426	0.03947	0.02112	-0.00223	0.00787
44	0.02526	0.03641	0.07984	0.03721	0.95584	-0.02760	0.23869	-0.07817	0.07268	0.11764	-0.00137	-0.00940	0.02334

OBS	WHCH_P	DYCH_N	DYCH_P	CKCH_N	CKCH_P	BOILLN	BOILLP	SCAPN	SCAPP	DRYERLP	DRYERLN	WATERLN	WATERLP
34	-0.00151	0.01956	0.21179	-0.00169	-0.00196	-0.00029	-0.00062	-0.00043	-0.00030	1.00000	0.00320	-0.00055	-0.00074
35	-0.00124	0.73591	0.00204	-0.00138	-0.00160	-0.00024	-0.00051	-0.00035	-0.00024	0.00320	1.00000	-0.00045	-0.00061
36	0.36068	-0.00061	-0.00258	-0.00253	-0.00293	0.02772	0.01964	-0.00064	-0.00044	-0.00055	-0.00045	1.00000	0.90761
37	0.48989	-0.00082	-0.00350	-0.00343	-0.00398	0.02498	0.01741	-0.00087	-0.00060	-0.00074	-0.00061	0.90761	1.00000
38	0.01237	-0.00149	-0.00633	0.42317	0.68245	-0.00105	-0.00227	0.00125	0.00220	-0.00134	-0.00109	-0.00200	-0.00271
39	0.02865	-0.00162	-0.00691	0.86327	0.71199	-0.00115	-0.00247	0.00376	0.00518	-0.00146	-0.00119	-0.00218	-0.00296
40	0.00316	-0.00462	-0.01953	-0.01137	-0.01967	-0.00264	0.03627	0.21911	0.16156	-0.00325	-0.00345	0.01093	0.00711
41	0.02715	-0.00740	-0.03131	0.00343	-0.00603	-0.00391	0.04184	0.41626	0.35968	-0.00528	-0.00544	0.05548	0.04600
42	0.00557	-0.00248	-0.01056	-0.01035	-0.01140	0.01226	0.00791	0.09223	0.09582	-0.00221	-0.00183	0.03007	0.02580
43	0.00761	0.00285	-0.00120	-0.00804	-0.01063	0.08580	0.11632	0.05423	0.03339	0.03205	0.00241	0.02162	0.01997
44	0.03344	0.01811	0.13564	0.04010	0.04528	0.00016	0.00597	0.04336	0.04975	0.05807	-0.00050	0.09784	0.10558

OBS	COOKLP	COOKLN	HEAT	SCAP	TALOAD	BOILD	WATERL	STOCKP	STOCKPM	COOKL	DRYERL
34	-0.00134	-0.00146	-0.00325	-0.00528	-0.00221	0.03205	0.05807	0.01818	0.01791	0.00237	0.06971
35	-0.00109	-0.00119	-0.00345	-0.00544	-0.00183	0.00241	-0.00050	0.11351	-0.00175	-0.01050	0.09739
36	-0.00200	-0.00218	0.01093	0.05548	0.03007	0.02162	0.09784	0.03131	-0.00320	0.05228	-0.00165
37	-0.00271	-0.00296	0.00711	0.04600	0.02580	0.01997	0.10558	0.04059	-0.00435	0.04009	0.01063
38	1.00000	0.50476	-0.00979	0.00102	-0.00687	-0.00510	0.04481	0.06675	0.06218	0.17182	0.00570
39	0.50476	1.00000	-0.01176	0.00081	-0.00894	-0.00758	0.05834	0.02153	0.11133	0.06075	-0.01075
40	-0.00979	-0.01176	1.00000	0.56536	0.15548	0.06511	0.08586	-0.00103	0.02533	0.05854	-0.01227
41	0.00102	0.00081	0.56536	1.00000	0.34327	0.07477	0.18980	0.01147	0.07956	0.20415	-0.00191
42	-0.00687	-0.00894	0.15548	0.34327	1.00000	0.03617	0.05460	0.00878	0.01388	0.12983	0.02322
43	-0.00510	-0.00758	0.06511	0.07477	0.03617	1.00000	0.02526	0.29838	0.00943	0.06195	0.05650
44	0.04481	0.05834	0.08586	0.18980	0.05460	0.02526	1.00000	0.05705	0.04462	0.15544	0.07964

OBS	_TYPE_	_NAME_	THERMS	SH	BOIL	WH	CK	DY	OT	HOURS	INDEX	HDD	SHC
45	CORR	STOCKP	0.14772	-0.06086	0.10269	-0.05841	-0.00198	0.11670	-0.00056	0.10730	0.04353	-0.02709	-0.00019
46	CORR	STOCKPM	0.04781	0.04726	0.03408	0.00574	0.07174	0.01000	0.01389	0.08947	-0.00651	-0.00819	0.05199
47	CORR	COOKL	0.36284	-0.00090	-0.05062	0.08309	0.43452	-0.03433	0.08715	0.32438	0.04983	-0.02485	0.10670
48	CORR	DRYERL	0.22613	-0.13856	0.28683	-0.22101	-0.20680	0.43528	0.02216	0.17498	0.00921	-0.01287	-0.01933

OBS	BOILC	TALOADC	COOKLC	DYC	WHC	DRYERLL	WATERLL	COOKLR	BCH_N	BCH_P	SHCH_N	SHCH_P	WHCH_N
45	0.29838	0.00731	0.11738	0.25607	0.04991	0.23226	0.03566	0.10053	0.01466	0.01062	0.01657	0.00264	0.03743
46	0.00943	0.00901	0.09035	-0.01215	0.03931	-0.01418	-0.00524	0.12080	0.01235	0.00990	-0.00764	-0.00930	-0.00734
47	0.06195	0.06398	0.90117	-0.05173	0.14201	-0.08789	-0.03250	0.55270	-0.00752	-0.02481	0.03293	-0.03039	0.03647
48	0.05650	0.00825	-0.08072	0.92126	0.05390	0.94958	0.03445	-0.11023	0.00240	0.03496	-0.00696	-0.00940	-0.00488

OBS	WHCH_P	DYCH_N	DYCH_P	CKCH_N	CKCH_P	BOILLN	BOILLP	SCAPN	SCAPP	DRYERLP	DRYERLN	WATERLN	WATERLP
45	0.04283	0.08830	-0.00721	0.02611	0.05260	0.00210	0.00295	-0.00296	-0.00134	0.01818	0.11351	0.03131	0.04059
46	-0.00866	-0.00227	-0.00062	0.19977	0.10546	-0.00161	0.00440	-0.00253	-0.00174	0.01791	-0.00175	-0.00320	-0.00435
47	0.02489	-0.01262	-0.02995	0.03694	0.07996	-0.00502	-0.01795	0.02294	0.00567	0.00237	-0.01050	0.05228	0.04009
48	0.00366	0.06988	-0.00111	-0.01330	-0.01150	-0.00270	0.00206	0.00996	0.01182	0.06971	0.09739	-0.00165	0.01063

OBS	COOKLP	COOKLN	HEAT	SCAP	TALOAD	BOILD	WATERL	STOCKP	STOCKPM	COOKL	DRYERL
45	0.06675	0.02153	-0.00103	0.01147	0.00878	0.29838	0.05705	1.00000	0.07738	0.14346	0.26722
46	0.06218	0.11133	0.02533	0.07956	0.01388	0.00943	0.04462	0.07738	1.00000	0.10857	-0.00938
47	0.17182	0.06075	0.05854	0.20415	0.12983	0.06195	0.15544	0.14346	0.10857	1.00000	-0.01777
48	0.00570	-0.01075	-0.01227	-0.00191	0.02322	0.05650	0.07964	0.26722	-0.00938	-0.01777	1.00000

APPENDIX C - SELECTED COMMERCIAL MODEL - SAS RESULTS

Model: MODEL1
NOTE: Restrictions have been applied to parameter estimates.
NOTE: Restrictions on intercept. R-square is redefined.
Dependent Variable: THERMS

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	23	1.3718835E12	59647107597	1078.115	0.0001
Error	19886	1.1002E12	55325354.885		
U Total	19909	2.4720835E12			

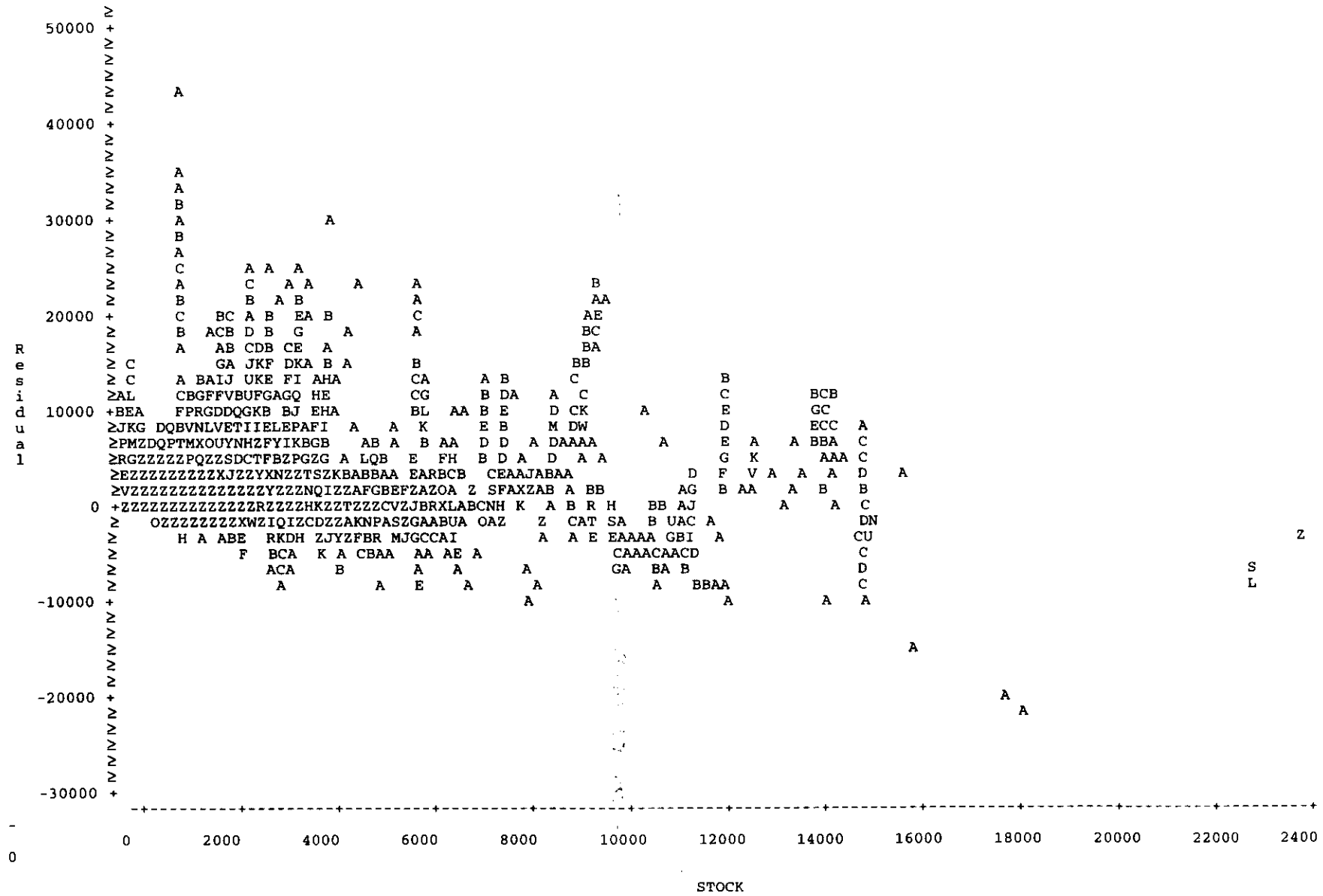
Root MSE	7438.10156	R-square	0.5550
Dep Mean	855.62753	Adj R-sq	0.5544
C.V.	869.31536		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > ≥T≥
INTERCEP	1	5.684342E-14	0.00000000	.	.
DRYERLL	1	-12.983938	0.61865120	-20.987	0.0001
WATERLL	1	6.438328	0.62379622	10.321	0.0001
COOKLR	1	3.167680	0.30447621	10.404	0.0001
BOILLN	1	-165.404385	38.41632301	-4.306	0.0001
BOILLP	1	584.784656	27.42922410	21.320	0.0001
SCAPN	1	-3.607064	0.54907580	-6.569	0.0001
SCAPP	1	4.994019	0.61970347	8.059	0.0001
DRYERLP	1	40.060729	2.31379376	17.314	0.0001
DRYERLN	1	-1.792355	1.70107839	-1.054	0.2921
WATERLN	1	-1.268909	3.37550334	-0.376	0.7070
WATERLP	1	-3.615070	3.05347149	-1.184	0.2365
COOKLP	1	1.757583	0.94418820	1.861	0.0627
COOKLN	1	4.330611	1.81383730	2.388	0.0170
HEAT	1	3.521090	0.08220563	42.833	0.0001
SCAP	1	0.582896	0.16271832	3.582	0.0003
TALOAD	1	6.046622	0.17471793	34.608	0.0001
BOILD	1	69.942054	2.49180199	28.069	0.0001
WATERL	1	2.344522	0.16058085	14.600	0.0001
STOCKP	1	-0.051021	0.01543550	-3.305	0.0010
CER	1	256.644726	72.07628187	3.561	0.0004
STOCKPM	1	-293.218777	103.66951465	-2.828	0.0047
COOKL	1	9.578763	0.23483500	40.789	0.0001
DRYERL	1	19.052272	0.59795589	31.862	0.0001
RESTRICT	-1	125291901	4974680.3084	25.186	0.0001

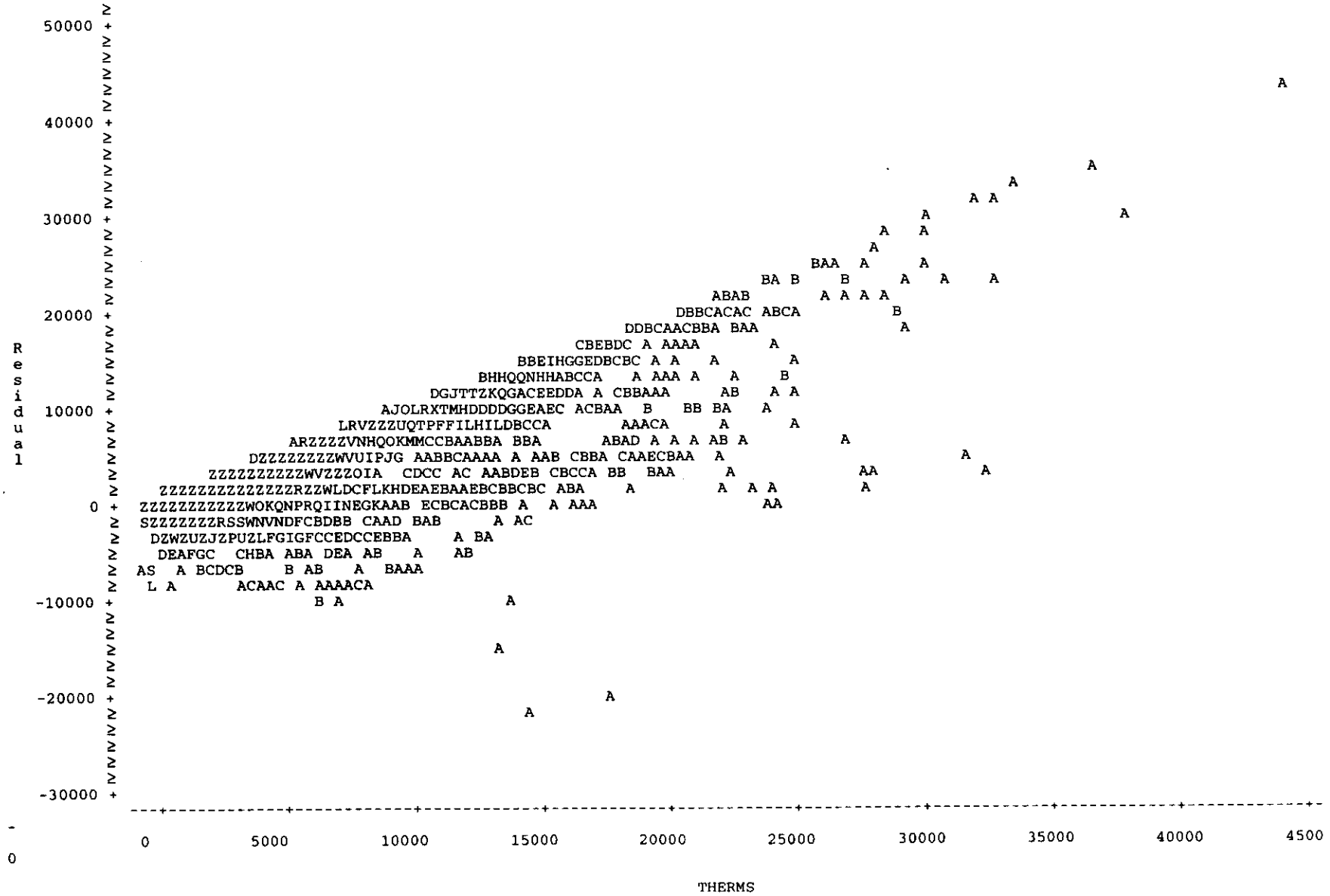
Durbin-Watson D	0.191
(For Number of Obs.)	19909
1st Order Autocorrelation	0.904

Plot of RESID*STOCK. Legend: A = 1 obs, B = 2 obs, etc.



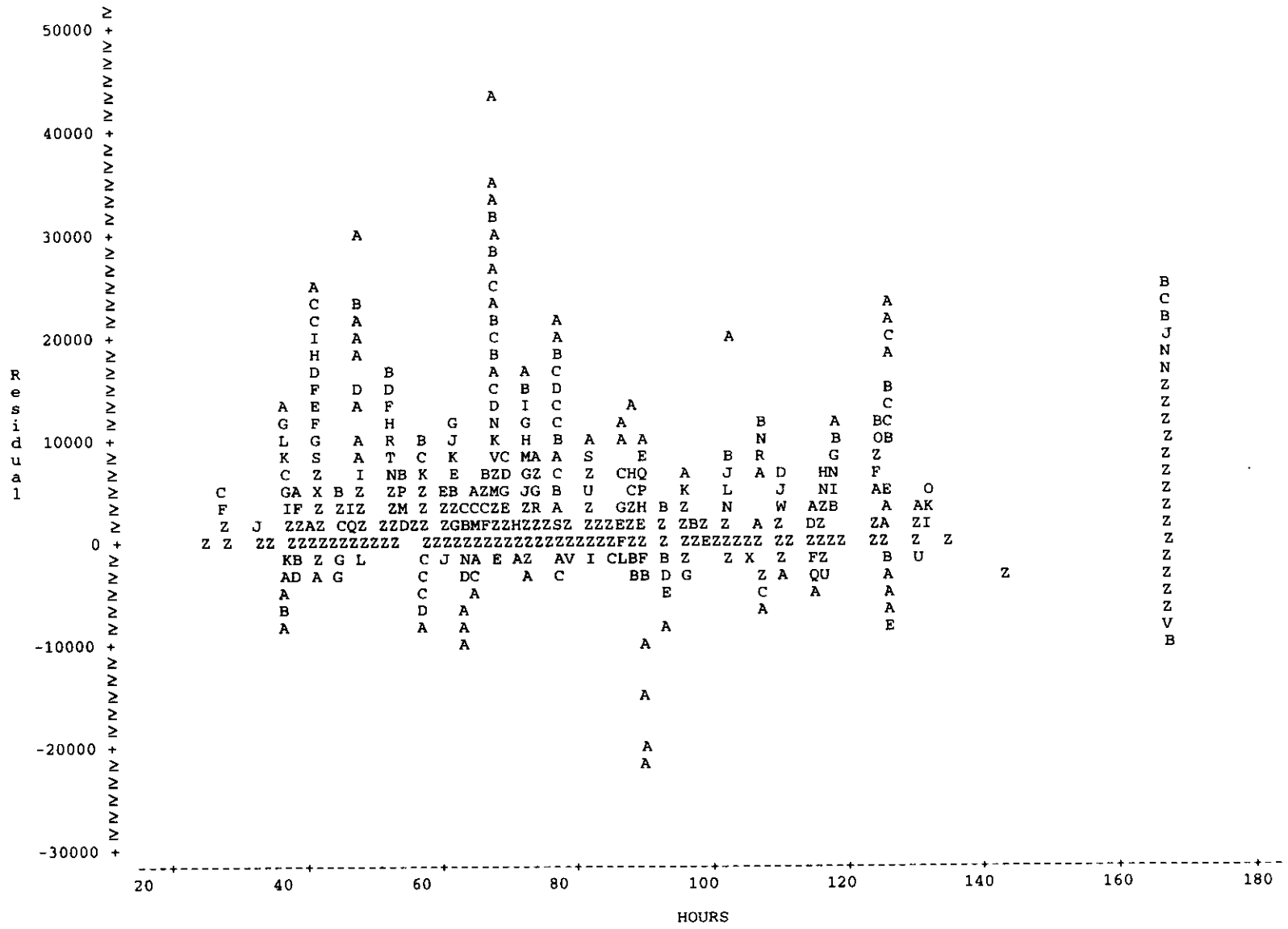
NOTE: 596 obs had missing values. 14736 obs hidden.

Plot of RESID*THERMS. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 596 obs had missing values. 16003 obs hidden.

Plot of RESID*HOURS. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 596 obs had missing values. 15191 obs hidden.

RHO1	Frequency	Percent	Cumulative Frequency	Cumulative Percent
.	14	2.4	14	2.4
-0.3	1	0.2	15	2.5
-0.1	2	0.3	17	2.9
0	3	0.5	20	3.4
0.1	1	0.2	21	3.6
0.2	3	0.5	24	4.1
0.3	5	0.8	29	4.9
0.4	7	1.2	36	6.1
0.5	9	1.5	45	7.6
0.6	19	3.2	64	10.8
0.7	36	6.1	100	16.9
0.8	62	10.5	162	27.4
0.9	119	20.1	281	47.5
1	310	52.5	591	100.0

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Analysis Variable : RHO

N	Mean	Std Dev	Minimum	Maximum
577	0.8829061	0.1820846	-0.2615102	0.9999265

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Model: MODEL1
NOTE: Restrictions have been applied to parameter estimates.
NOTE: Restrictions on intercept. R-square is redefined.
Dependent Variable: DTHM

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	23	140688129430	6116875192.6	1168.796	0.0001
Error	19309	101053356024	5233484.6975		
U Total	19332	241741485454			

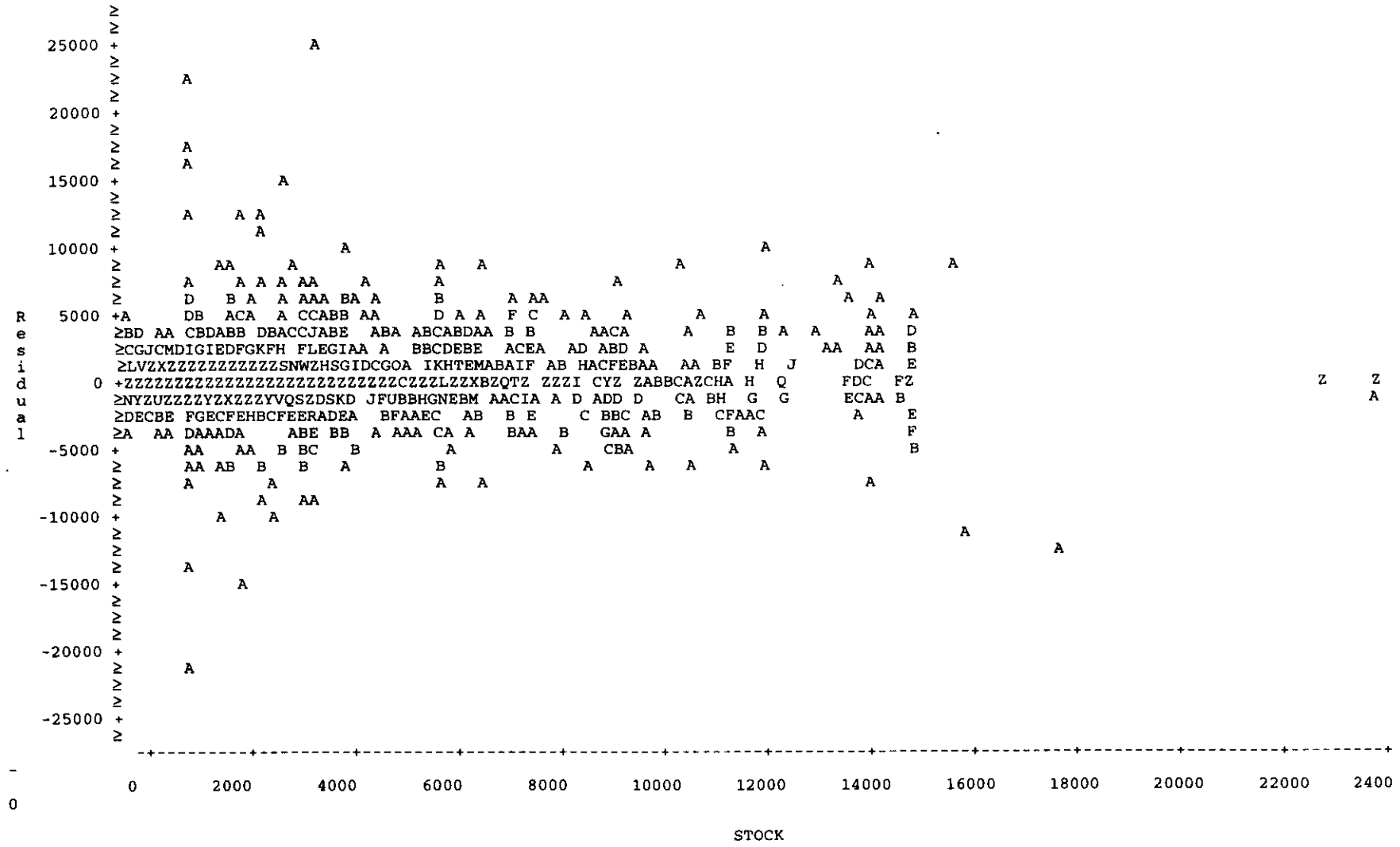
Root MSE	2287.68107	R-square	0.5820
Dep Mean	102.33192	Adj R-sq	0.5815
C.V.	2235.54985		

Parameter Estimates

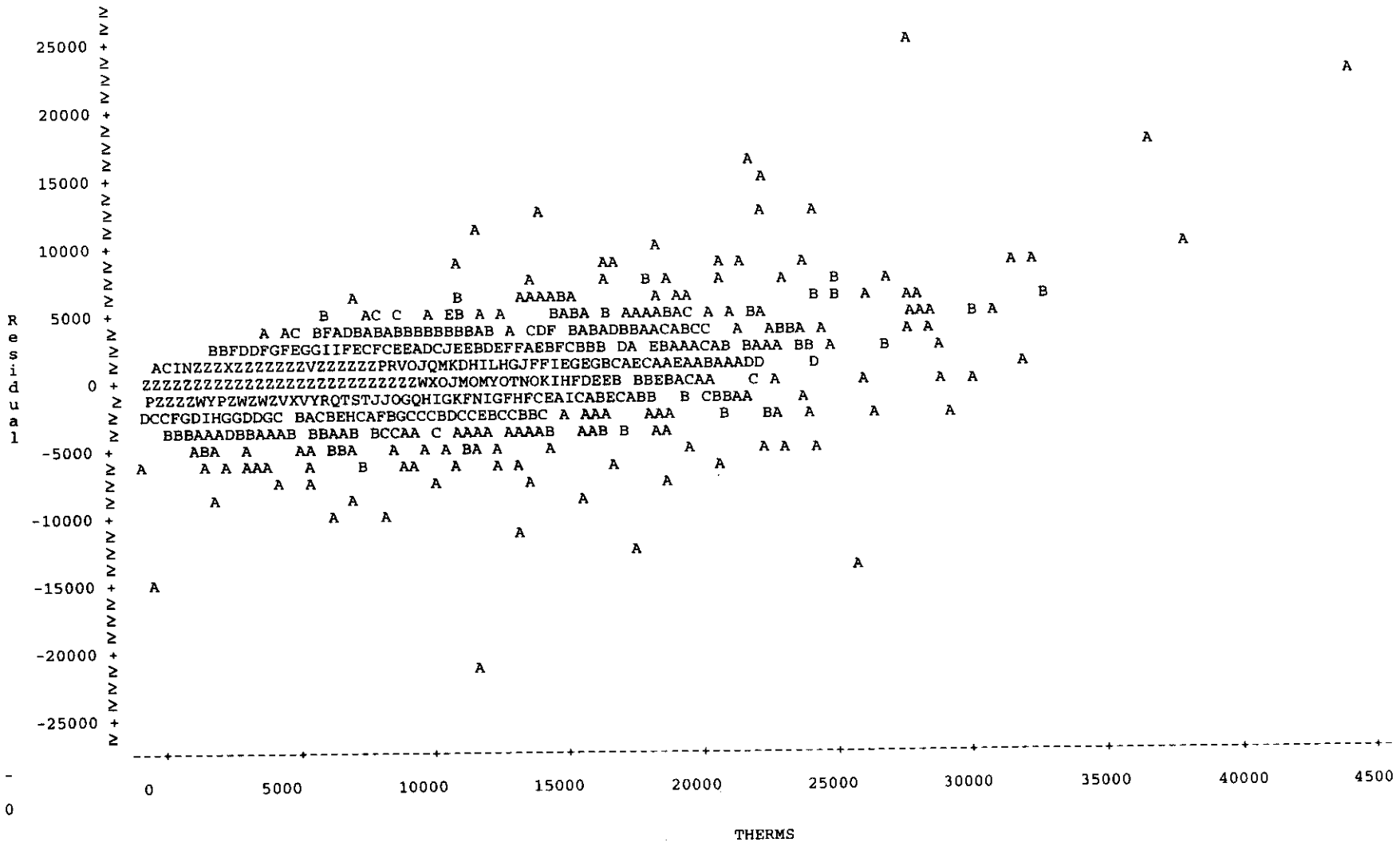
Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > ≥T≥
INTERCEP	1	-3.33067E-15	0.00000000	.	.
DDRYERLL	1	-8.061381	0.94424318	-8.537	0.0001
DWATERLL	1	5.823183	0.48651475	11.969	0.0001
DCOOKLR	1	4.589713	0.49856670	9.206	0.0001
DBOILLN	1	-282.809590	38.76446524	-7.296	0.0001
DBOILLP	1	265.074762	24.60630071	10.773	0.0001
DSCAPN	1	-4.029769	0.35516927	-11.346	0.0001
DSCAPP	1	4.791124	0.35831218	13.371	0.0001
DDRYERLN	1	-0.531113	1.86563976	-0.285	0.7759
DDRYERLP	1	13.801630	2.58469493	5.340	0.0001
DWATERLN	1	2.544090	3.14798338	0.808	0.4190
DWATERLP	1	-2.402302	2.89188051	-0.831	0.4062
DCOOKLP	1	0.993868	0.67704760	1.468	0.1421
DCOOKLN	1	0.818466	1.59330720	0.514	0.6075
DHEAT	1	2.274412	0.03891161	58.451	0.0001
DSCAP	1	1.509174	0.11923988	12.657	0.0001
DTALOAD	1	5.793617	0.17002791	34.075	0.0001
DBOILD	1	234.408005	13.83027930	16.949	0.0001
DWATERL	1	3.085909	0.23704119	13.018	0.0001
DSTOCKP	1	0.014238	0.01882780	0.756	0.4495
DSTOCKM	1	-109.824082	86.51123587	-1.269	0.2043
DCER	1	260.170374	75.14942539	3.462	0.0005
DCOOKL	1	8.255552	0.37892120	21.787	0.0001
DDRYERL	1	14.052824	0.82522954	17.029	0.0001
RESTRICT	-1	2319820	1891446.4978	1.226	0.2200

Durbin-Watson D	1.835
(For Number of Obs.)	19332
1st Order Autocorrelation	0.082

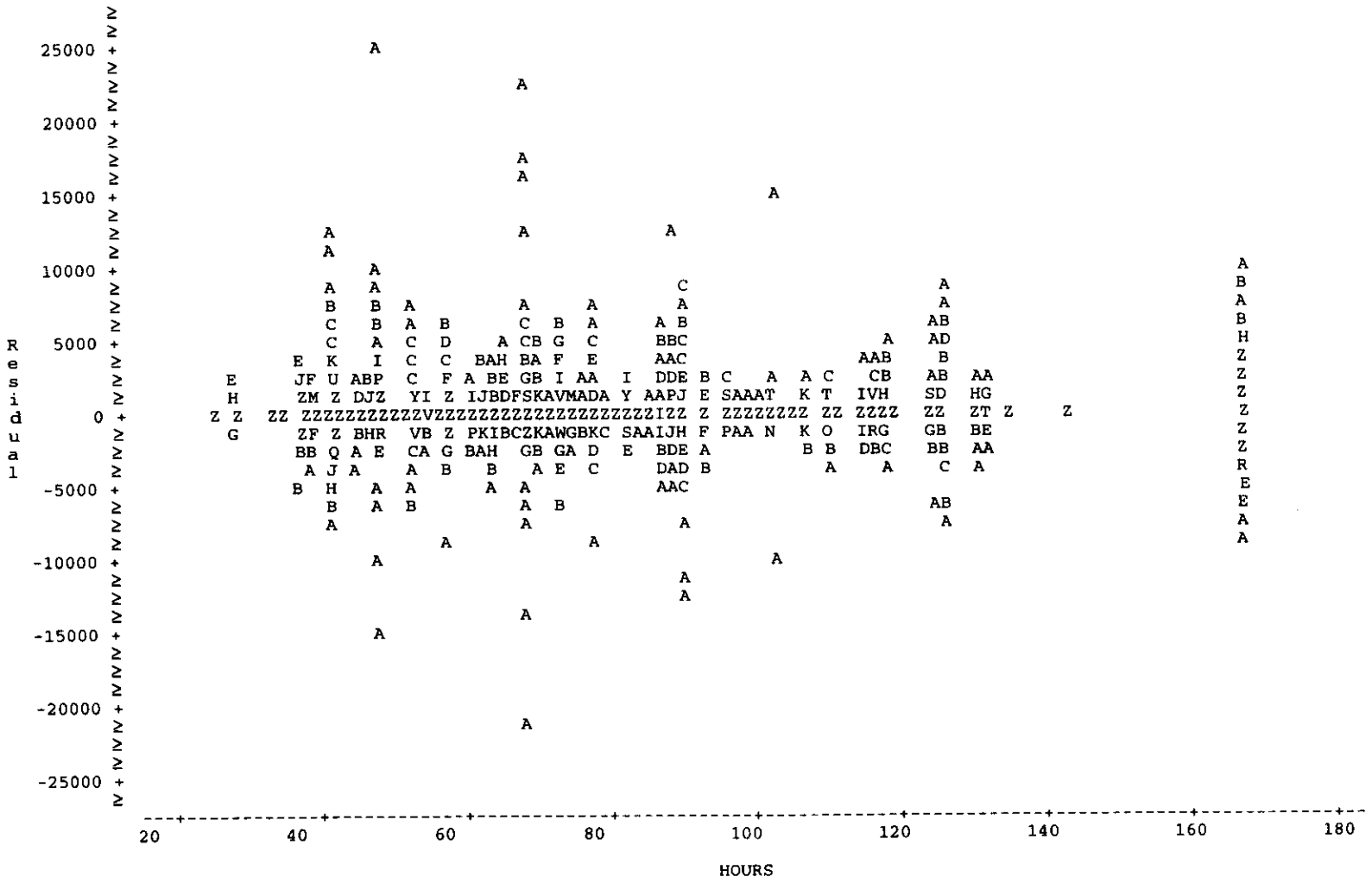
Plot of RESID*STOCK. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 582 obs had missing values. 16002 obs hidden.



NOTE: 582 obs had missing values. 16208 obs hidden.



NOTE: 582 obs had missing values. 16201 obs hidden.

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Model: MODEL1
Dependent Variable: RES

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	23	5.2002876E17	2.2609946E16	93.214	0.0001
Error	19308	4.683331E18	2.425591E14		
C Total	19331	5.2033598E18			

Root MSE	15574308.8321	R-square	0.0999
Dep Mean	120332.14348	Adj R-sq	0.0989
C.V.	12942.76690		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > ≥T≥
INTERCEP	1	4828254	202079.51177	23.893	0.0001
CND	1	-2.522792	7.75515668	-0.325	0.7450
CND2	1	-0.701286	1.06707652	-0.657	0.5111
CND3	1	-0.362979	0.32066275	-1.132	0.2577
CND4	1	0.279026	0.05130417	5.439	0.0001
CND5	1	-0.172114	0.09026473	-1.907	0.0566
F_CND	1	-4713404	219184.95182	-21.504	0.0001
F_CND2	1	-4712911	200872.56197	-23.462	0.0001
F_CND3	1	-4650003	202174.98188	-23.000	0.0001
F_CND4	1	-4565321	205487.70310	-22.217	0.0001
F_CND5	1	-4142721	212827.19975	-19.465	0.0001
IP	1	0.935848	0.10324344	9.064	0.0001
PART	1	0.044212	0.08156766	0.542	0.5878
F_PART	1	30458	37855.744859	0.805	0.4211
IND	1	-0.661443	0.19100821	-3.463	0.0005
F_IND	1	-232959	44998.687054	-5.177	0.0001
IND2	1	-0.502802	0.09246132	-5.438	0.0001
IND3	1	-1.090811	0.11293059	-9.659	0.0001
IND4	1	-0.707716	0.33311493	-2.125	0.0336
IND5	1	-0.741478	0.10301394	-7.198	0.0001
F_IND2	1	-75012	85726.772004	-0.875	0.3816
F_IND3	1	-188526	66446.028697	-2.837	0.0046
F_IND4	1	-77931	108925.35394	-0.715	0.4743
F_IND5	1	353048	104311.85506	3.385	0.0007

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Model: MODEL1
NOTE: Restrictions have been applied to parameter estimates.
NOTE: Restrictions on intercept. R-square is redefined.
Dependent Variable: DTHM

Analysis of Variance

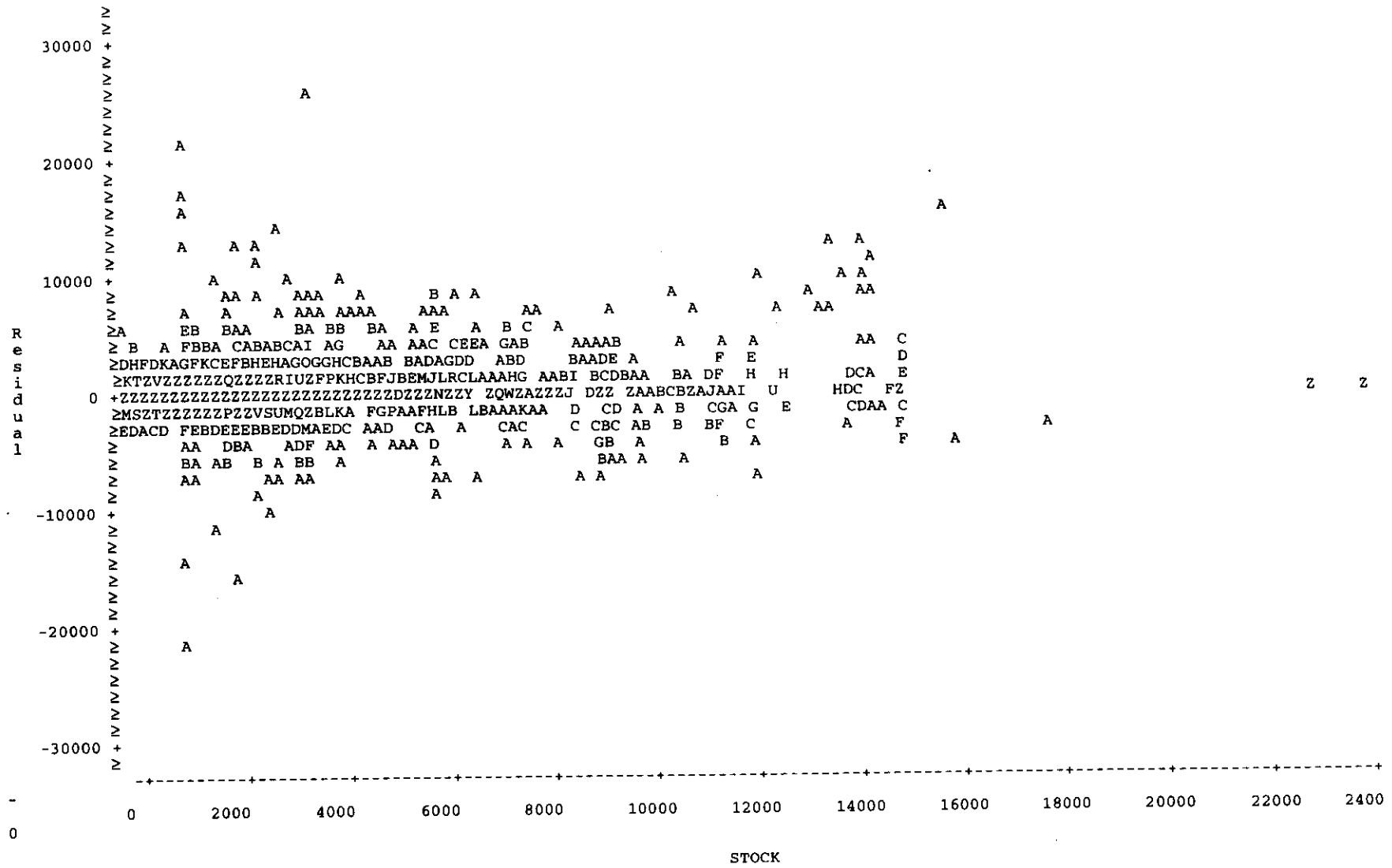
Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	23	346378.18662	15059.92116	1405.097	0.0001
Error	19309	206955.08105	10.71806		
U Total	19332	553333.26767			

Root MSE	3.27385	R-square	0.6260
Dep Mean	64.37623	Adj R-sq	0.6255
C.V.	5.08549		

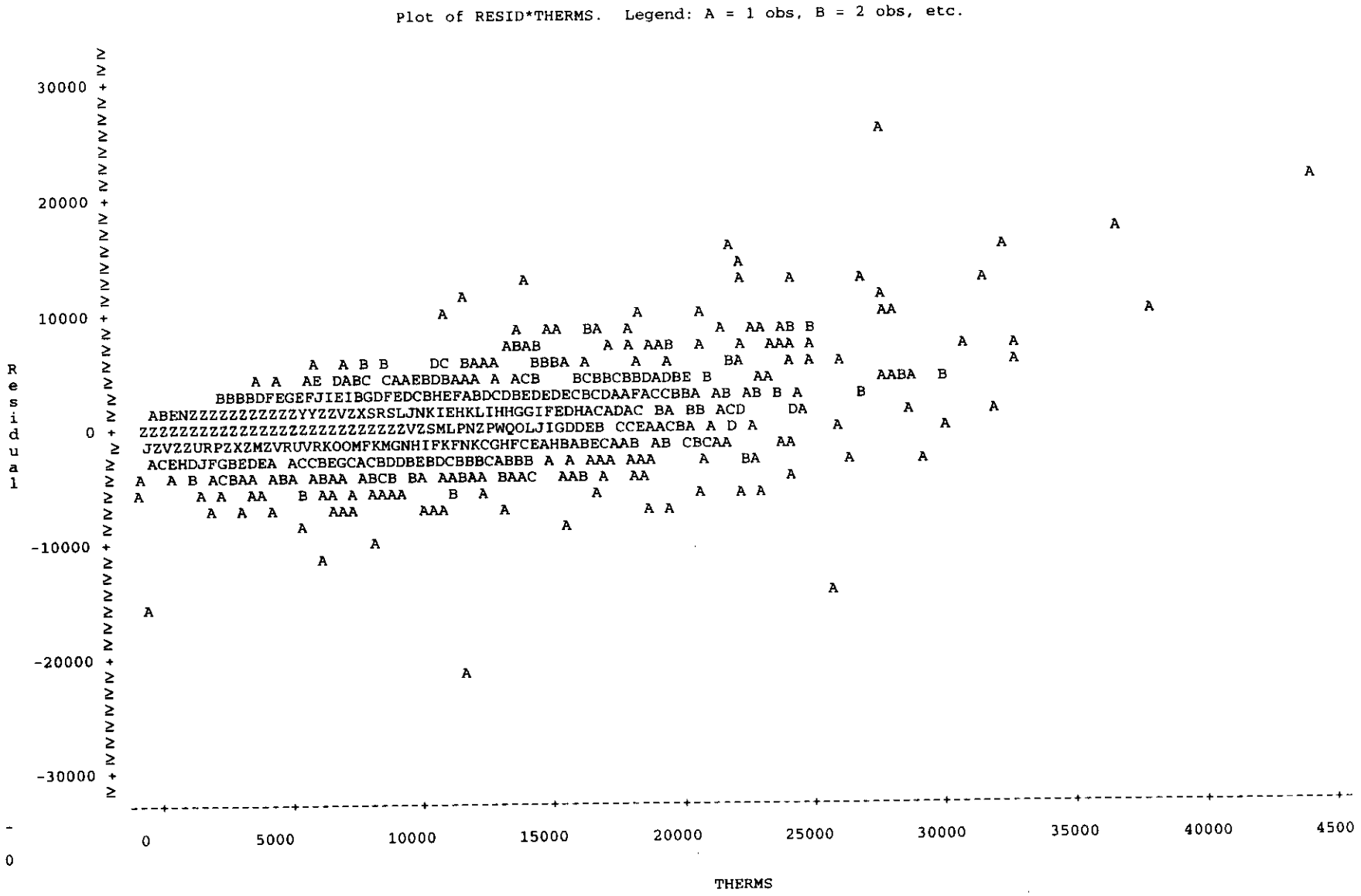
Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > ≥T≥
INTERCEP	1	1.360023E-15	0.00000000	.	.
DDRYERLL	1	-7.473477	0.77183568	-9.683	0.0001
DWATERLL	1	6.560830	0.22737319	28.855	0.0001
DCOOKLR	1	4.821523	0.34791838	13.858	0.0001
DBOILLN	1	-128.625744	96.16415551	-1.338	0.1811
DBOILLP	1	156.499651	37.28586189	4.197	0.0001
DSCAPN	1	-3.550974	0.63771415	-5.568	0.0001
DSCAPP	1	4.630804	0.79979419	5.790	0.0001
DDRYERLN	1	-0.264946	0.61758643	-0.429	0.6679
DDRYERLP	1	-3.664809	2.46086116	-1.489	0.1364
DWATERLN	1	0.191224	1.28814111	0.148	0.8820
DWATERLP	1	-0.983951	1.14547440	-0.859	0.3904
DCOOKLP	1	1.132018	0.70518732	1.605	0.1085
DCOOKLN	1	-1.131104	1.09373159	-1.034	0.3011
DHEAT	1	1.013667	0.03007728	33.702	0.0001
DSCAP	1	1.732768	0.04714228	36.756	0.0001
DTALOAD	1	5.638673	0.46940589	12.012	0.0001
DBOILD	1	252.867093	17.45254515	14.489	0.0001
DWATERL	1	2.853071	0.20252042	14.088	0.0001
DSTOCKP	1	-0.028875	0.00810825	-3.561	0.0004
DSTOCKM	1	-89.177053	35.36848851	-2.521	0.0117
DCER	1	129.875006	32.83946747	3.955	0.0001
DCOOKL	1	7.738399	0.33181954	23.321	0.0001
DDRYERL	1	13.127968	0.60965669	21.533	0.0001
RESTRICT	-1	6.552862	10.31614574	0.635	0.5253

Plot of RESID*STOCK. Legend: A = 1 obs, B = 2 obs, etc.

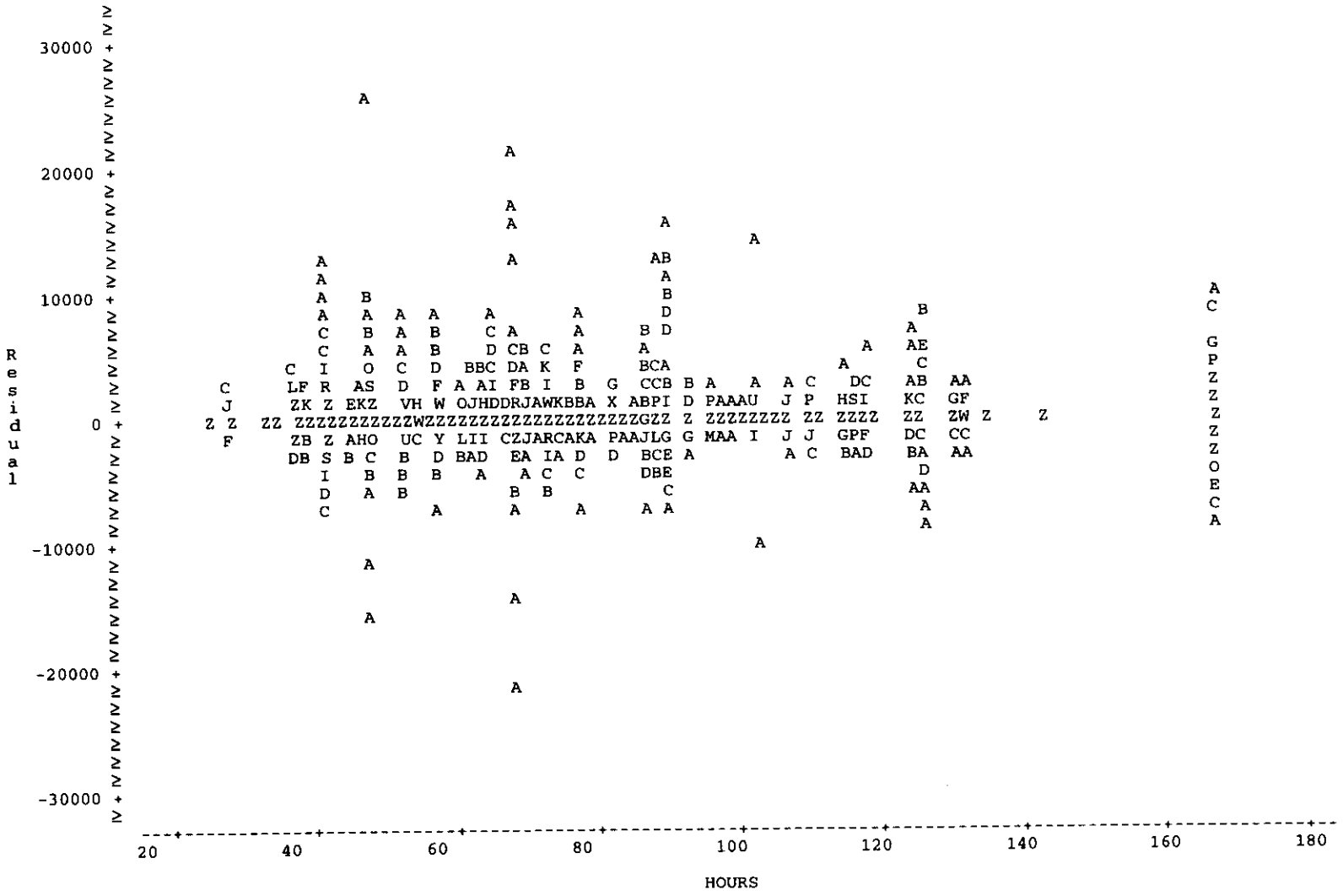


NOTE: 582 obs had missing values. 16155 obs hidden.



NOTE: 582 obs had missing values. 16347 obs hidden.

Plot of RESID*HOURS. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 582 obs had missing values. 16329 obs hidden.

APPENDIX D - ALTERNATIVE COMMERCIAL MODEL - SAS RESULTS

Model: MODEL1
NOTE: Restrictions have been applied to parameter estimates.
NOTE: Restrictions on intercept. R-square is redefined.
Dependent Variable: THERMS

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	23	1.8247803E12	79338273941	612.355	0.0001
Error	31658	4.1016908E12	129562538.01		
U Total	31681	5.9264711E12			

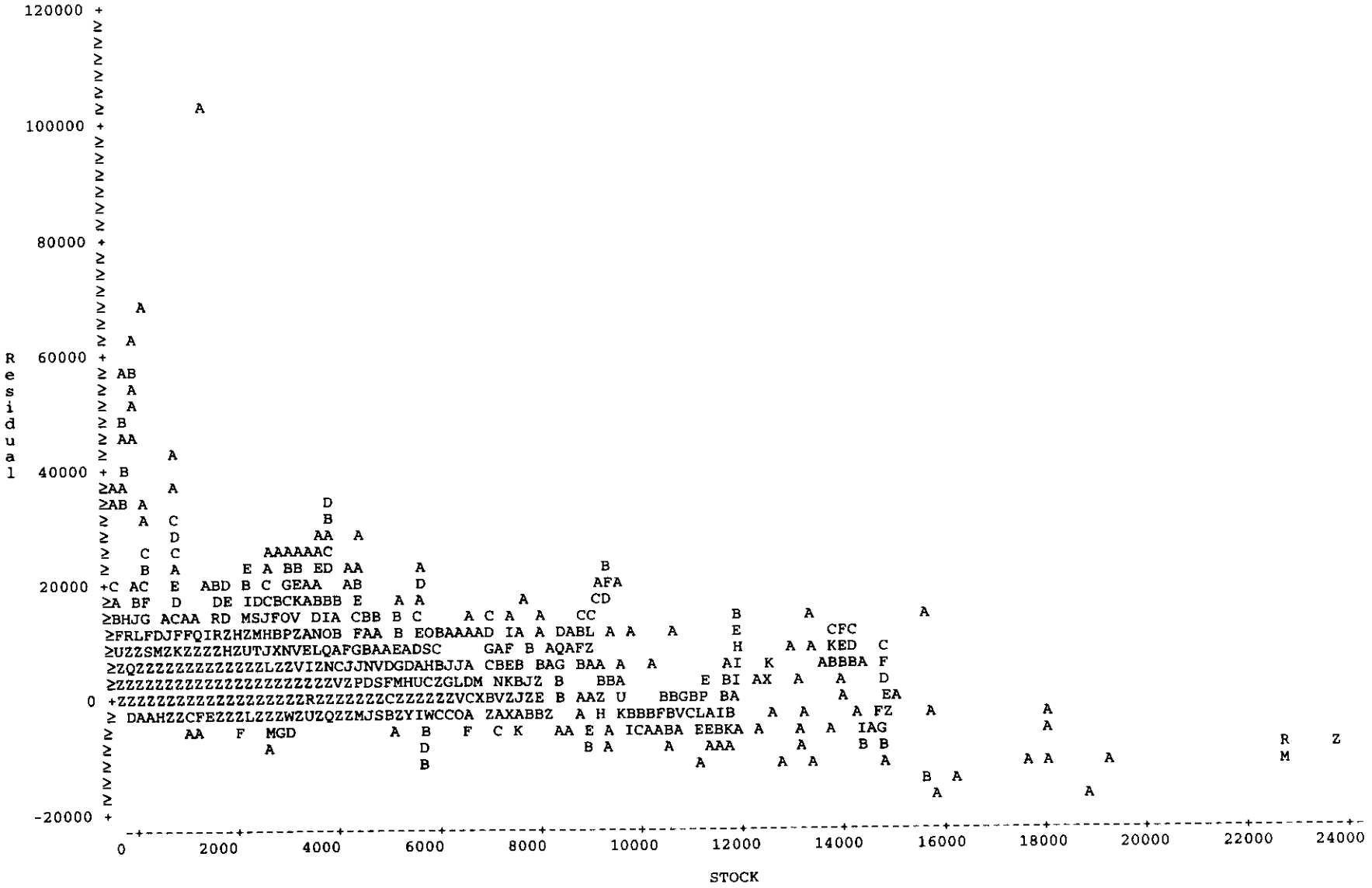
Root MSE	11382.55411	R-square	0.3079
Dep Mean	769.53483	Adj R-sq	0.3074
C.V.	1479.14735		

Parameter Estimates

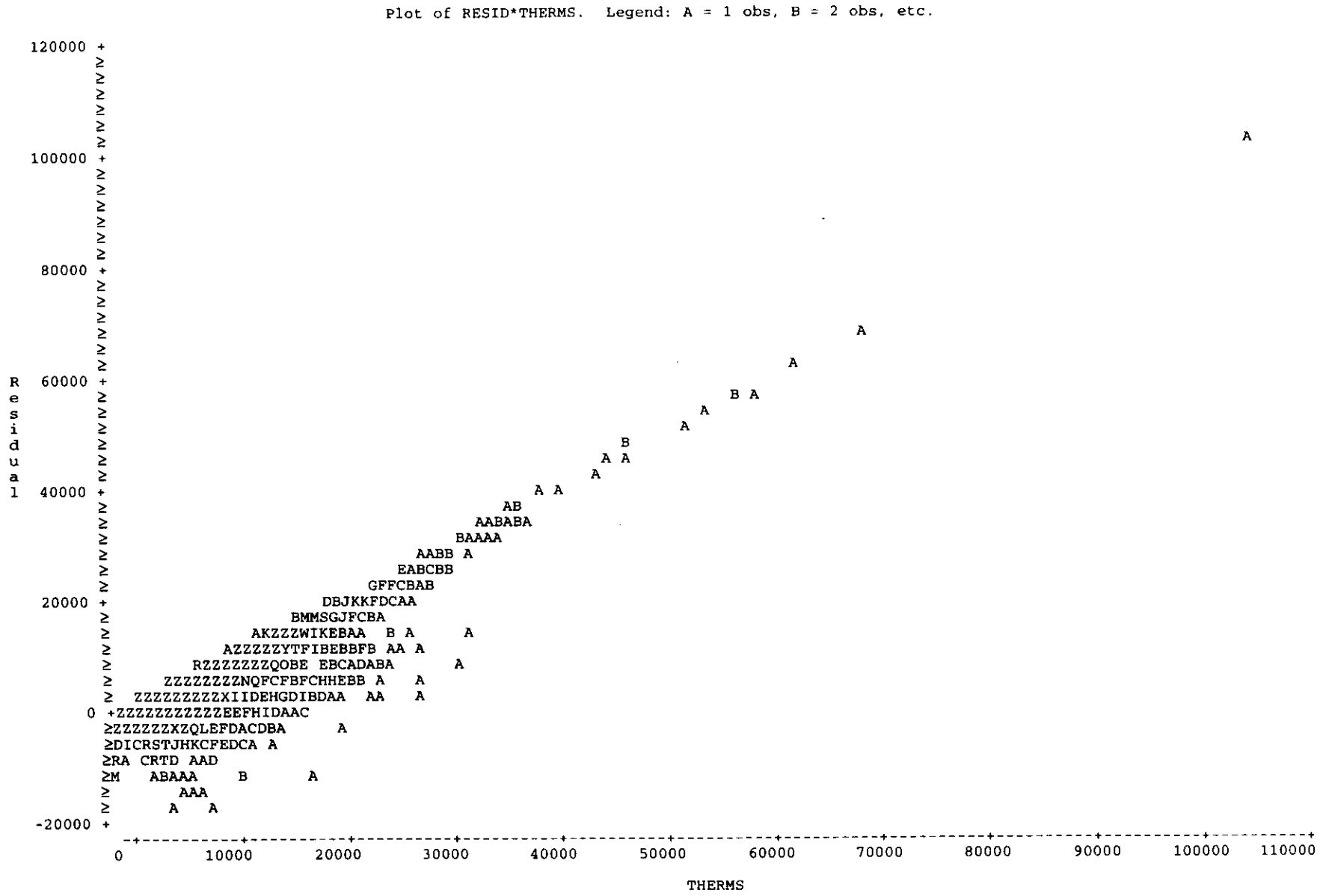
Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > ≥T≥
INTERCEP	1	1.136868E-13	0.00000000	.	.
DRYERLL	1	-12.869790	0.88569440	-14.531	0.0001
WATERLL	1	6.469732	0.82276705	7.863	0.0001
COOKLR	1	2.400393	0.40372376	5.946	0.0001
BOILLN	1	-60.058626	38.19283454	-1.573	0.1158
BOILLP	1	497.346513	34.59735391	14.375	0.0001
SCAPN	1	0.167885	0.65639356	0.256	0.7981
SCAPP	1	3.800750	0.71434603	5.321	0.0001
DRYERLP	1	36.983170	3.49920040	10.569	0.0001
DRYERLN	1	-1.424746	2.60511840	-0.547	0.5844
WATERLN	1	1.831279	2.82670432	0.648	0.5171
WATERLP	1	-5.999644	2.27838614	-2.633	0.0085
COOKLP	1	2.589628	1.39770651	1.853	0.0639
COOKLN	1	1.371060	2.48277698	0.552	0.5808
HEAT	1	1.749553	0.05517321	31.710	0.0001
SCAP	1	0.382649	0.13466759	2.841	0.0045
TALOAD	1	4.054510	0.17688257	22.922	0.0001
BOILD	1	111.728584	3.51011521	31.830	0.0001
WATERL	1	3.572381	0.21387315	16.703	0.0001
STOCKP	1	-0.092814	0.02189584	-4.239	0.0001
CER	1	386.050366	108.41043902	3.561	0.0004
STOCKPM	1	-409.415678	155.90873775	-2.626	0.0086
COOKL	1	9.678403	0.30571693	31.658	0.0001
DRYERL	1	18.994149	0.85282567	22.272	0.0001
RESTRICT	-1	285624570	10833993.591	26.364	0.0001

Durbin-Watson D	0.226
(For Number of Obs.)	31681
1st Order Autocorrelation	0.887

Plot of RESID*STOCK. Legend: A = 1 obs, B = 2 obs, etc.

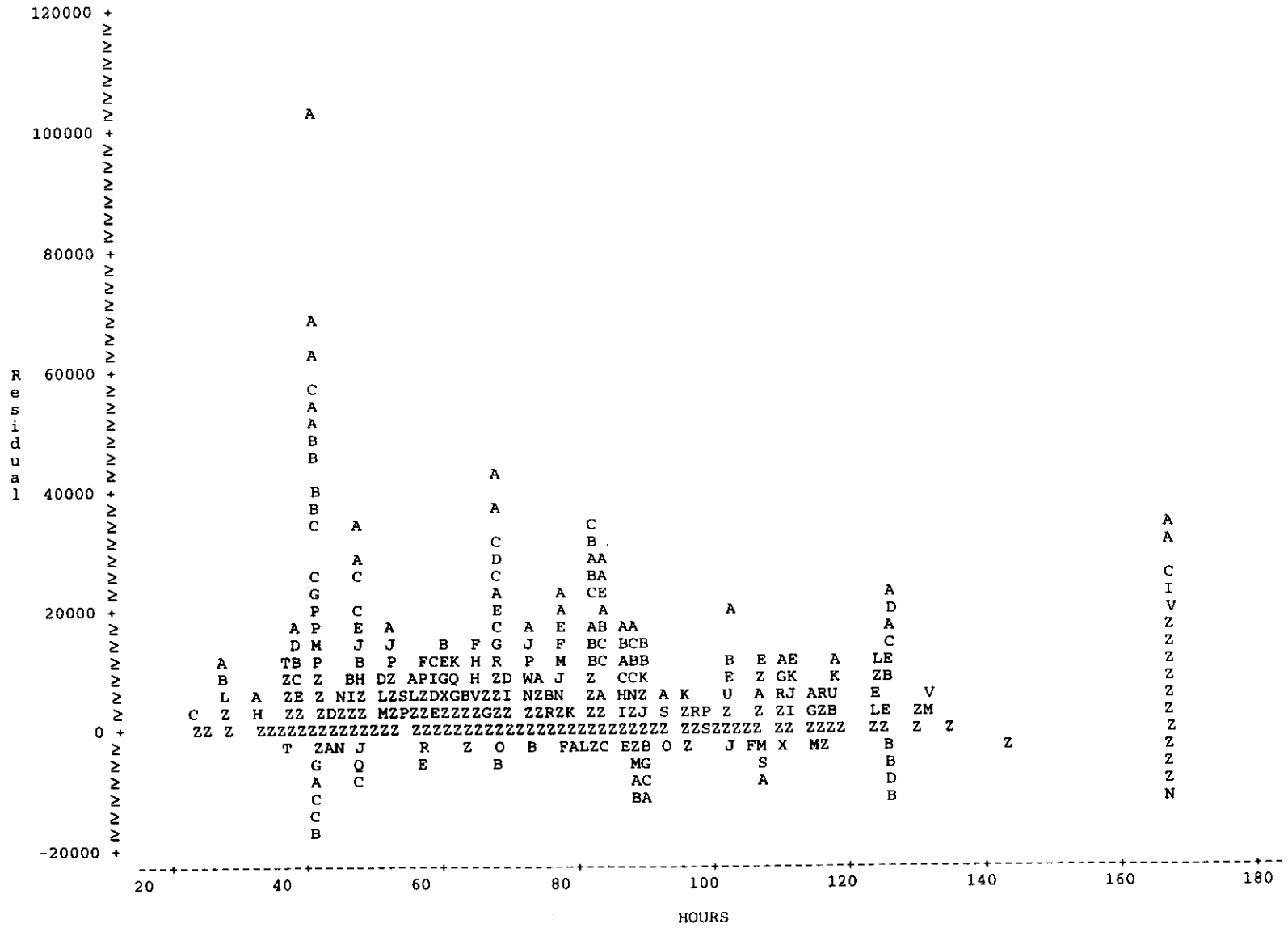


NOTE: 875 obs had missing values. 26721 obs hidden.



NOTE: 875 obs had missing values. 29425 obs hidden.

Plot of RESID*HOURS. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 875 obs had missing values. 27072 obs hidden.

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RHO1	Frequency	Percent	Cumulative Frequency	Cumulative Percent
.	21	2.2	21	2.2
-0.2	1	0.1	22	2.3
0	4	0.4	26	2.8
0.1	1	0.1	27	2.9
0.2	6	0.6	33	3.5
0.3	9	1.0	42	4.5
0.4	13	1.4	55	5.8
0.5	21	2.2	76	8.1
0.6	29	3.1	105	11.1
0.7	72	7.6	177	18.8
0.8	134	14.2	311	33.0
0.9	233	24.7	544	57.7
1	398	42.3	942	100.0

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Analysis Variable : RHO

N	Mean	Std Dev	Minimum	Maximum
921	0.8672201	0.1703898	-0.2166677	0.9999710

Model: MODEL1
NOTE: Restrictions have been applied to parameter estimates.
NOTE: Restrictions on intercept. R-square is redefined.
Dependent Variable: DTHM

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	23	113460150412	4933050017.9	300.883	0.0001
Error	30737	503940839171	16395251.299		
U Total	30760	617400989582			

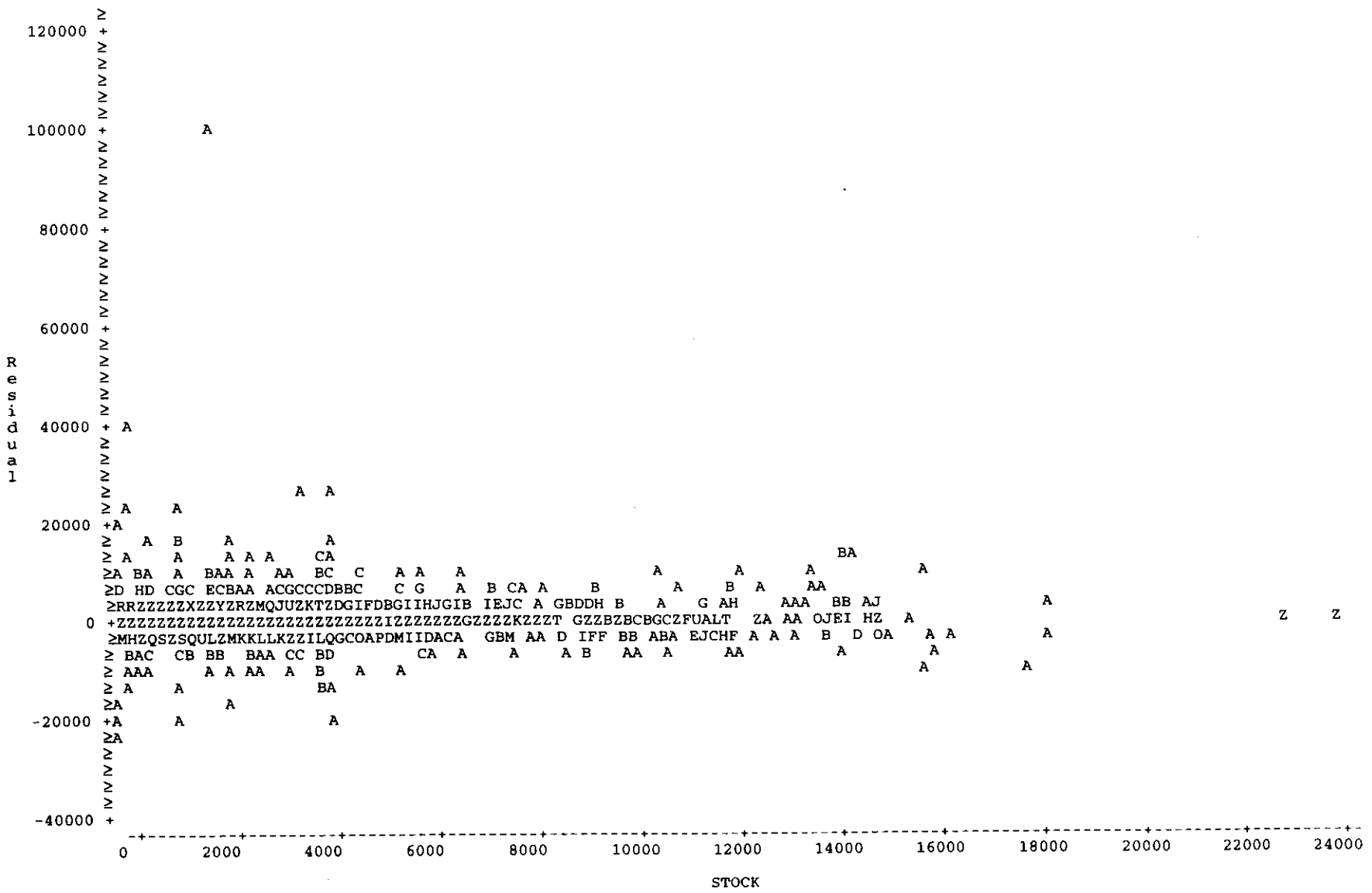
Root MSE	4049.10500	R-square	0.1838
Dep Mean	88.76183	Adj R-sq	0.1832
C.V.	4561.76387		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-3.33067E-15	0.00000000	.	.
DDRYERLL	1	-11.517675	1.74804953	-6.589	0.0001
DWATERLL	1	6.002067	0.81977730	7.322	0.0001
DCOOKLR	1	3.340511	0.70490385	4.739	0.0001
DBOILLN	1	-196.913327	38.47426316	-5.118	0.0001
DBOILLP	1	226.371750	37.26285638	6.075	0.0001
DSCAPN	1	0.366624	0.53273515	0.688	0.4913
DSCAPP	1	1.920148	0.54944662	3.495	0.0005
DDRYERLN	1	-0.421305	3.31580587	-0.127	0.8989
DDRYERLP	1	5.825874	4.78095613	1.219	0.2230
DWATERLN	1	-0.449986	2.75109998	-0.164	0.8701
DWATERLP	1	-1.288458	2.18393135	-0.590	0.5552
DCOOKLP	1	1.259593	1.13993341	1.105	0.2692
DCOOKLN	1	0.274505	2.52998293	0.109	0.9136
DHEAT	1	1.425180	0.03482591	40.923	0.0001
DSCAP	1	0.679280	0.16039414	4.235	0.0001
DTALOAD	1	4.597649	0.27785129	16.547	0.0001
DBOILD	1	200.243648	10.99378914	18.214	0.0001
DWATERL	1	3.992825	0.43376558	9.205	0.0001
DSTOCKP	1	0.028400	0.03119112	0.911	0.3626
DSTOCKM	1	-533.845181	160.36638315	-3.329	0.0009
DCER	1	823.866145	145.65569227	5.656	0.0001
DCOOKL	1	8.386134	0.52639307	15.931	0.0001
DDRYERL	1	17.162696	1.40773106	12.192	0.0001
RESTRICT	-1	9026543	4448917.4415	2.029	0.0425

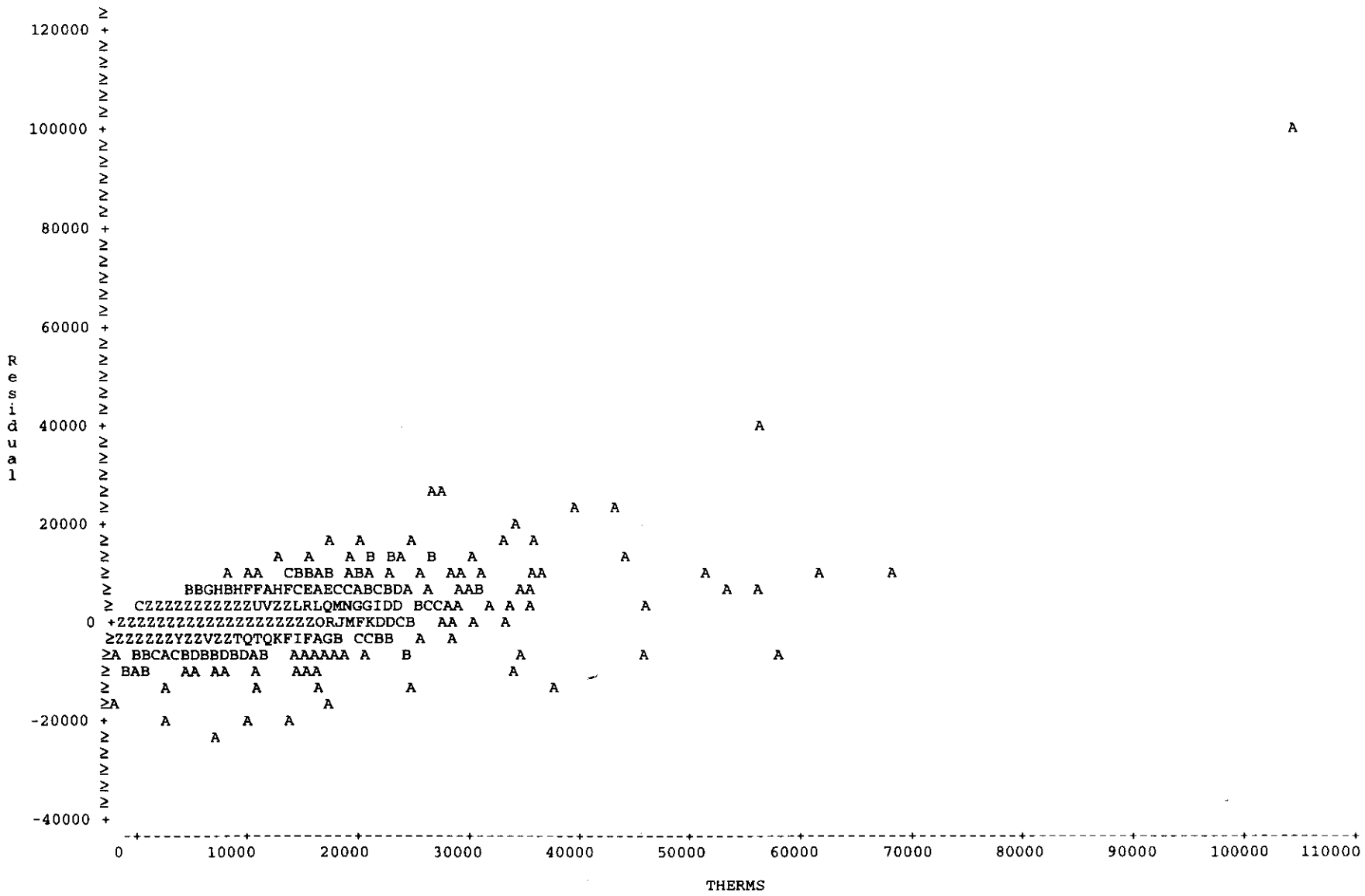
Durbin-Watson D	1.515
(For Number of Obs.)	30760
1st Order Autocorrelation	0.242

Plot of RESID*STOCK. Legend: A = 1 obs, B = 2 obs, etc.



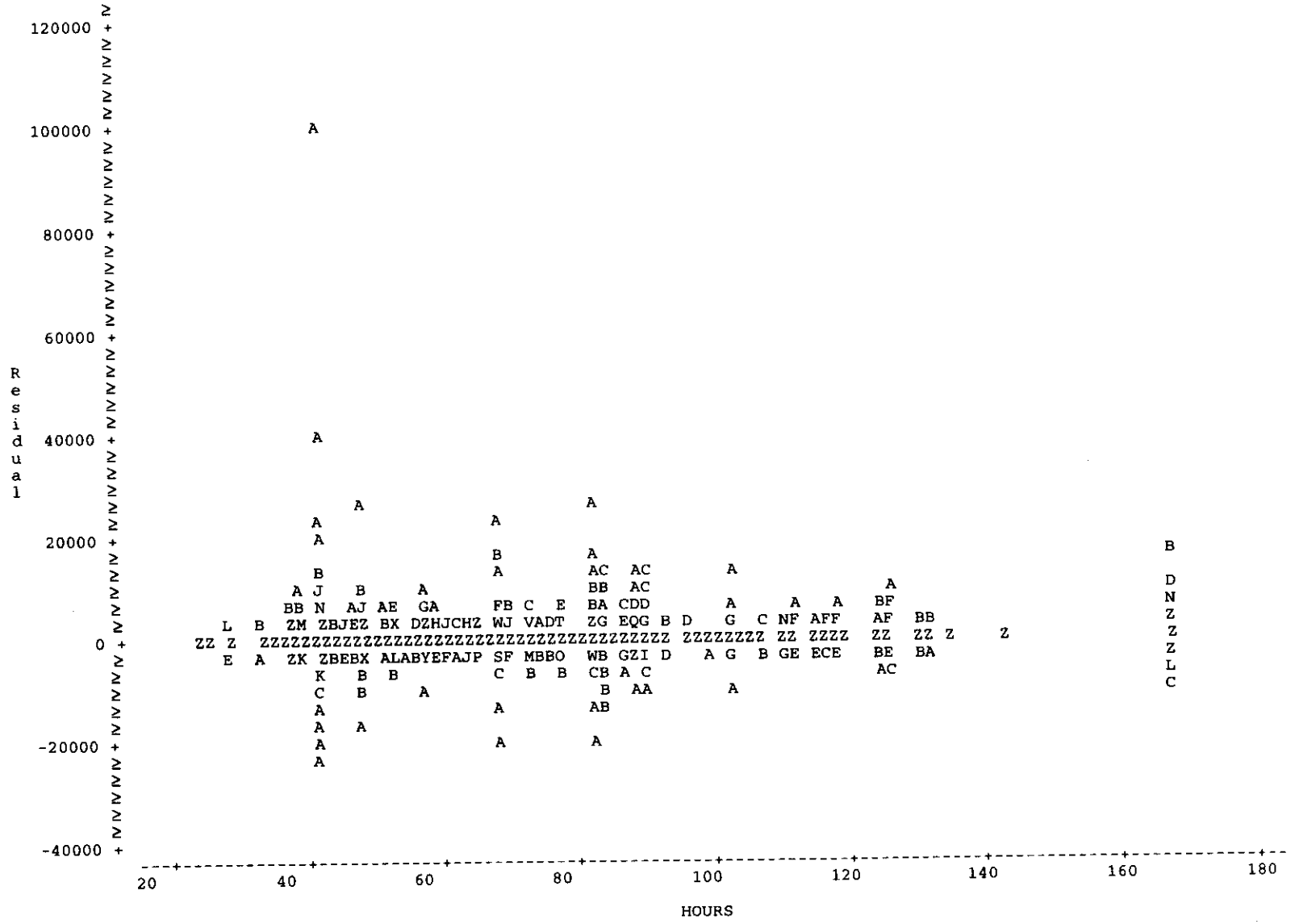
NOTE: 854 obs had missing values. 27849 obs hidden.

Plot of RESID*THERMS. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 854 obs had missing values. 28979 obs hidden.

Plot of RESID*HOURS. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 854 obs had missing values. 28034 obs hidden.

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Model: MODEL1
Dependent Variable: RES

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	33	1.4744588E19	4.4680569E17	21.693	0.0001
Error	30726	6.3284341E20	2.0596349E16		
C Total	30759	6.4758799E20			

Root MSE	143514280.027	R-square	0.0228
Dep Mean	340028.99685	Adj R-sq	0.0217
C.V.	42206.48279		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	7137478	1738900.5617	4.105	0.0001
CND	1	-17.215662	92.01432572	-0.187	0.8516
CND2	1	-0.828595	10.61771788	-0.078	0.9378
CND3	1	-0.794073	2.47488734	-0.321	0.7483
CND4	1	-0.576899	0.51961875	-1.110	0.2669
CND5	1	-0.730521	1.07065392	-0.682	0.4950
F_CND	1	-7077333	1909772.8310	-3.706	0.0002
F_CND2	1	-7101597	1739513.0057	-4.083	0.0001
F_CND3	1	-7021176	1753449.4986	-4.004	0.0001
F_CND4	1	-6861111	1786560.3918	-3.840	0.0001
F_CND5	1	-6487517	1861550.4606	-3.485	0.0005
GND	1	-6.751716	97.34505899	-0.069	0.9447
GND2	1	-1.308560	11.73816981	-0.111	0.9112
GND3	1	85.147635	4.24531728	20.057	0.0001
GND4	1	0.649503	0.54116129	1.200	0.2301
GND5	1	0.040281	1.05352266	0.038	0.9695
BND	1	-447349	944099.78399	-0.474	0.6356
BND2	1	-166810	372175.45720	-0.448	0.6540
BND3	1	-655739	628878.96205	-1.043	0.2971
BND4	1	193024	785161.88072	0.246	0.8058
BND5	1	1813313	1516156.3746	1.196	0.2317
IP	1	1.475263	0.97744096	1.509	0.1312
PART	1	-2.281025	1.02833436	-2.218	0.0266
F_PART	1	-118684	281450.82867	-0.422	0.6733
IND	1	-0.449840	1.67934307	-0.268	0.7888
F_IND	1	-111459	342006.78047	-0.326	0.7445
IND2	1	0.416245	1.01939173	0.408	0.6830
IND3	1	0.363996	1.51067804	0.241	0.8096
IND4	1	-2.066789	2.81605650	-0.734	0.4630
IND5	1	-0.705902	0.95467086	-0.739	0.4597
F_IND2	1	75085	573443.07175	0.131	0.8958
F_IND3	1	-87468	523119.50671	-0.167	0.8672
F_IND4	1	-172834	671598.48677	-0.257	0.7969
F_IND5	1	1687222	478467.87535	3.526	0.0004

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Model: MODEL1
NOTE: Restrictions have been applied to parameter estimates.
NOTE: Restrictions on intercept. R-square is redefined.
Dependent Variable: DTHM

Analysis of Variance

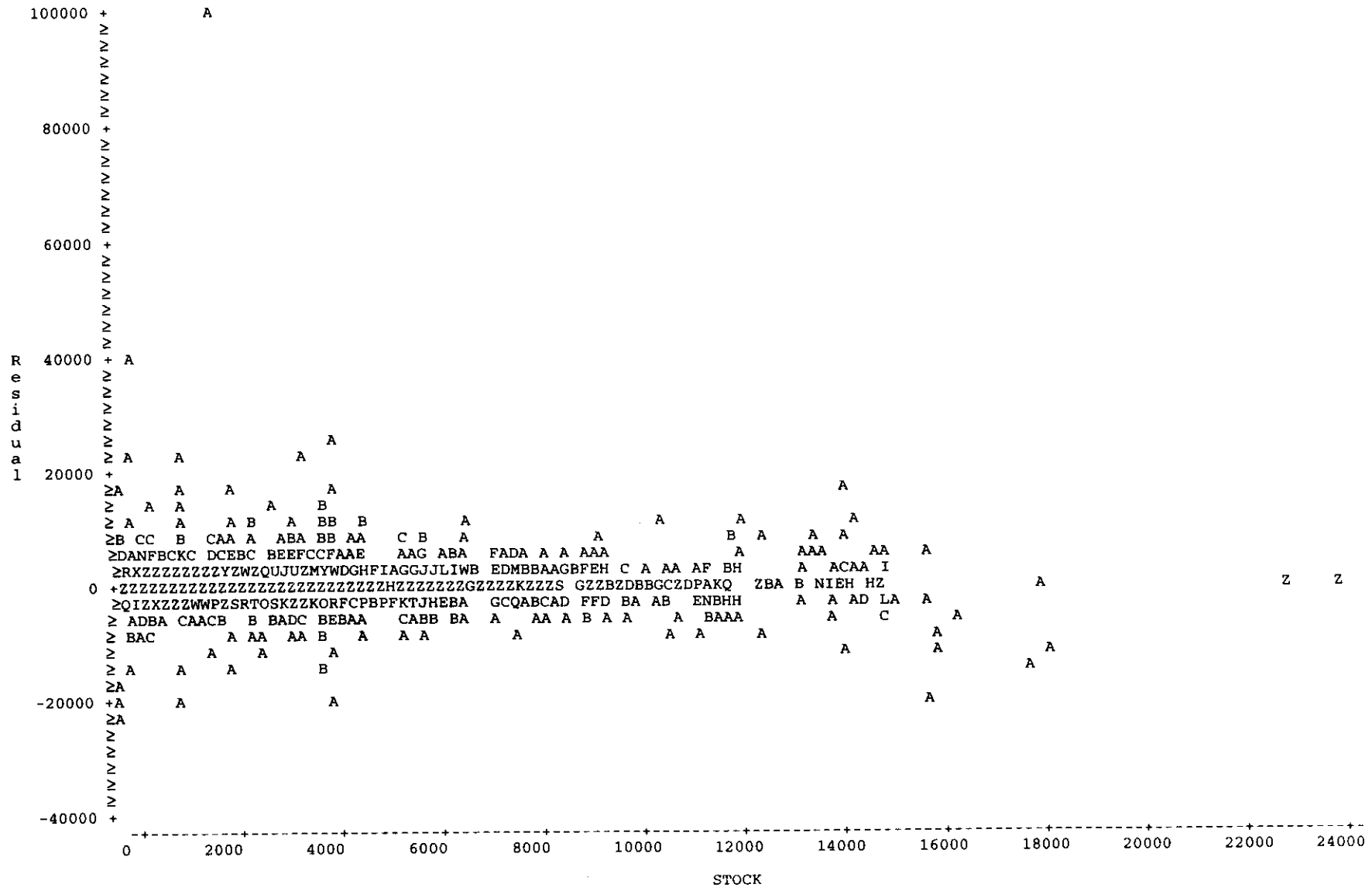
Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	23	371598.83374	16156.47103	181.705	0.0001
Error	30737	2733016.1041	88.916163064		
U Total	30760	3104614.9378			

Root MSE	9.42954	R-square	0.1197
Dep Mean	41.57611	Adj R-sq	0.1190
C.V.	22.68018		

Parameter Estimates

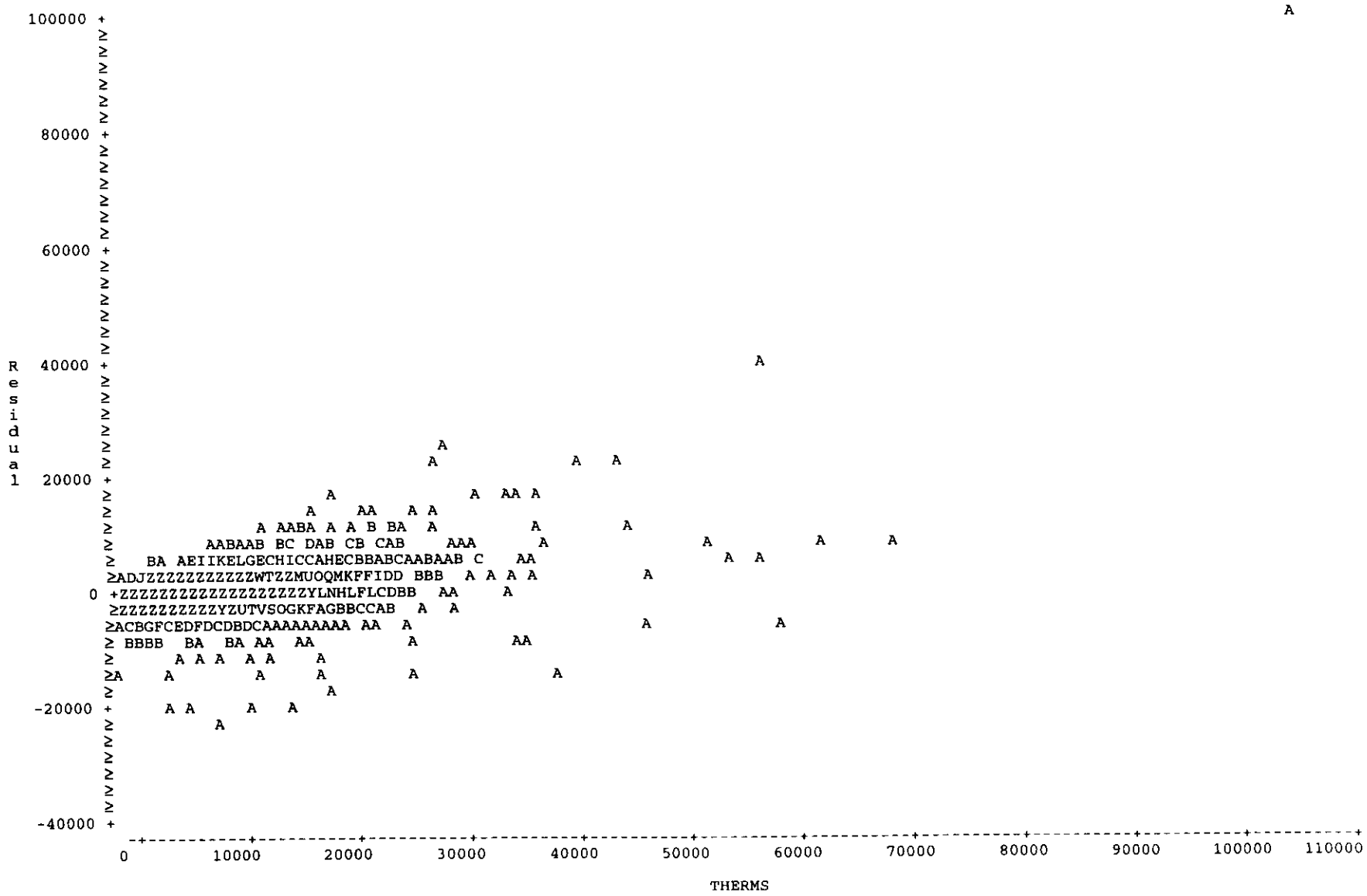
Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > ≥T≥
INTERCEP	1	3.552714E-15	0.00000000	.	.
DDRYERLL	1	-15.082999	3.16108914	-4.771	0.0001
DWATERLL	1	6.289584	2.59627068	2.423	0.0154
DCOOKLR	1	1.414401	0.89285903	1.584	0.1132
DBOILLN	1	-182.846267	112.86928669	-1.620	0.1052
DBOILLP	1	159.353419	94.29226830	1.690	0.0910
DSCAPN	1	-1.278854	1.82343601	-0.701	0.4831
DSCAPP	1	-0.208816	1.24466828	-0.168	0.8668
DDRYERLN	1	-0.262282	4.01675648	-0.065	0.9479
DDRYERLP	1	-8.188221	2.29725065	-3.564	0.0004
DWATERLN	1	3.687550	4.07196751	0.906	0.3652
DWATERLP	1	-3.024094	3.22197715	-0.939	0.3480
DCOOKLP	1	0.606267	2.93977341	0.206	0.8366
DCOOKLN	1	-0.656712	3.69969107	-0.178	0.8591
DHEAT	1	2.430760	0.04957823	49.029	0.0001
DSCAP	1	2.202422	0.22845962	9.640	0.0001
DTALOAD	1	2.045494	1.04759183	1.953	0.0509
DBOILD	1	207.509312	33.31689280	6.228	0.0001
DWATERL	1	2.196624	0.60497432	3.631	0.0003
DSTOCKP	1	-0.007346	0.02997635	-0.245	0.8064
DSTOCKM	1	-29.603641	157.47419030	-0.188	0.8509
DCER	1	85.116705	141.04388766	0.603	0.5462
DCOOKL	1	10.097562	0.76009044	13.285	0.0001
DDRYERL	1	20.754236	2.22964656	9.308	0.0001
RESTRICT	-1	544.194986	50.02805433	10.878	0.0001

Plot of RESID*STOCK. Legend: A = 1 obs, B = 2 obs, etc.



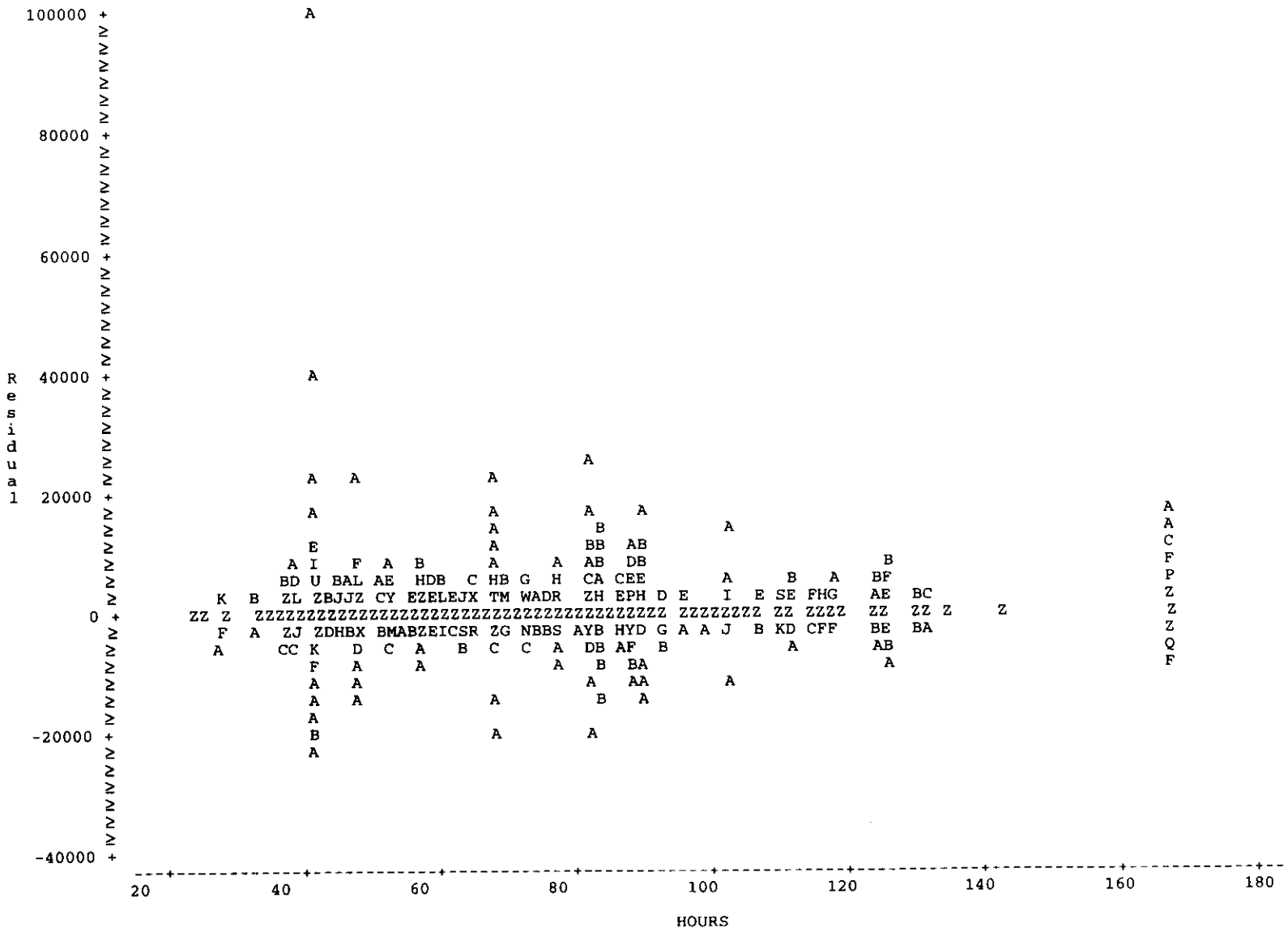
NOTE: 854 obs had missing values. 27620 obs hidden.

Plot of RESID*THERMS. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 854 obs had missing values. 28867 obs hidden.

Plot of RESID*HOURS. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 854 obs had missing values. 27867 obs hidden.

TABLES 6 AND 7

TABLE 6 PROTOCOLS FOR REPORTING OF RESULTS OF IMPACT MEASUREMENT STUDIES USED TO SUPPORT AN EARNINGS CLAIM

1. Average Participant Group and Average Comparison Group Usage (therms)

Annual Therm Usage Pre and Post Audit

Unit	A. Pre Audit Use	B. Post Audit Use
Program Participants		
Surveyed Participant Account	13,323	13,183
Participant That Took Some Action Account	15,334	15,249
Survey Non-Respondent Account	9,242	9,500
Comparison Group		
Surveyed Comparison Group Account	6,404	6,236
Non-Respondent Comparison Group Account	5,475	5,694

Note: Comparison group customers were assigned an audit date of July 15, 1996 for pre and post usage comparisons.

2. Average net and gross end use load impacts (therms) for the 1996 program year.

	Unit type	Total
A.&B. Avg. load impacts	average audited commercial account	127 therms
C. Percent change in usage	average audited commercial account	1.2%
D. Realization rates	average audited commercial account	21.1%

3. Net to Gross Ratio:

Impacts in Section 2 above are net impacts. The use of a conditional demand model allows direct calculation of net impacts (i.e., "net" in terms of actions taken by non-participants). Since SoCalGas selected customers to be audited the free-ridership associated with some rebate type programs is not an issue).

4. Designated Unit Intermediate Data

Billing data, equipment holdings, production data (where available), and audit data are all included in the machine-readable file, CEMS96.ZIP, which is included with this report.

5. Precision of Load Impact Estimates

The precision of the audit impact estimates at the 90% and 80% confidence levels are shown (on a per customer basis) below

CEMS Per Customer Annualized Therm Savings

End-Use	Restaurant	Lodging	Laundry	Health	Education	Other	Total
Boiler	51.0	48.0	30.0	569.0	166.0	82.0	73.0
90% CONF.	28.8	41.8	25.2	649.6	82.9	59.2	52.3
80% CONF.	22.4	32.6	19.6	506.3	64.6	46.2	40.8
Space Heat	11.0	21.0	15.0	34.0	52.0	28.0	21.0
90% CONF.	4.3	16.9	6.1	21.9	27.6	11.4	6.7
80% CONF.	3.3	13.2	4.7	17.1	21.5	8.8	5.3
Water Heat	6.0	53.0	9.0	38.0	8.0	7.0	11.0
90% CONF.	4.4	50.8	7.7	35.9	12.8	8.2	9.0
80% CONF.	3.5	39.6	6.0	27.9	10.0	6.4	7.1
Cooking	83.0	71.0	0.0	101.0	32.0	79.0	80.0
90% CONF.	63.8	86.2	0.0	101.3	28.8	67.0	65.0
80% CONF.	49.7	67.2	0.0	79.0	22.4	52.2	50.6
Dryer	57.0	120.0	347.0	152.0	16.0	42.0	195.0
90% CONF.	44.9	112.0	291.0	132.8	27.0	46.1	169.4
80% CONF.	35.0	87.3	226.8	103.5	21.0	35.9	132.0
Misc.	45.0	69.0	660.0	20.0	74.0	220.0	130.0
90% CONF.	29.3	118.1	345.6	9.9	61.7	4.4	51.2
80% CONF.	22.8	92.0	269.3	7.7	48.1	3.5	39.9
Overall	95.1	196.2	204.9	413.4	154.6	94.0	126.6
90% CONF.	70.4	192.6	170.6	425.5	100.9	61.9	95.9
80% CONF.	54.8	150.1	132.9	331.6	78.6	48.3	74.7

6. Measure Count Data

Measure count data (i.e., actions taken due to the audit) for program participants was not available in any consistent and comprehensive form from the SoCalGas audit records. The participant survey was not successful in rectifying this matter due to most respondent's inability to recollect details from the audit.

TABLE 7 DOCUMENTATION PROTOCOLS FOR DATA QUALITY AND PROCESSING

A. OVERVIEW INFORMATION

1. Study title

First Year Load Impact Study of Southern California Gas Company's 1996 Commercial Energy Management Services Program

Study ID 712

2. Program/program year

Commercial Energy Management Services (CEMS), Program Year 1996

Program description

SoCalGas' 1996 CEMS program provided energy efficiency information (via direct contact with SoCalGas account executives and interns) to the Company's core commercial customers (SIC 1-19, 40-99, not including pumping).

3. End uses covered

End uses – boiler, space heat, water heat, cooking, dryers, other (misc.)

4. Methods and models used

Conditional demand analysis model; specification discussed on pages 19-35 of the report.

5. Participant and comparison group definition

Participants and non-participants included SoCalGas nonresidential core customers with consumption between 500- 250,000 therms annually, whose two digit SIC code was not 20-39. Some restaurants with less than 500 therms annual consumption were included. .

6. Analysis sample size

The analysis data set was constructed from survey respondents as follows:

Category	Participant Group	Comparison Group
Initial Respondents	674	492
Respondents with Sufficient Billing History	644	450
Respondents with Equipment Capacity Data	612	330
Respondents with Consumption Change Not >15% from '96-'97	401	190

An average of 33 months of consumption data was available for each participant

B. DATABASE MANAGEMENT

1. Flow chart illustrating the relationships between data elements

Included on page 16 of the report.

2. Identify the specific data sources ...

See pages 9-18 of the report. Primary sources were monthly billing data, participant and comparison group surveys, weather data (HDD), and customer-specific equipment data from Gas Company records.

3. Diagram and describe the data attrition process...

Discussion of the attrition process is included on pages 15-18 of the report. Customers were deleted from both the participant group and comparison group for lack of sufficient billing history, lack of equipment capacity data, and inexplicable consumption change (plus or minus 15% from 1996-97)

4. Describe the internal/organizational data quality checks...

See pages 15-18 of the report.

5. Provide a summary of the data collected specifically ...

Employed survey data are included in the analytic dataset, CEMS96.ZIP. A copy of the raw survey responses can be obtained from J. Green of SoCalGas.

C. SAMPLING

1. Sampling procedures and protocols

See pages 11-15 of the report.

2. Survey information

Appendix A includes the participant and comparison group survey instruments. The survey is discussed on pages 11-12.

3. Statistical descriptions

Only a limited amount of data was employed from the survey, primarily production data. Statistical descriptions of the survey dataset were not prepared, although statistics for analytic variables are included in Appendix B of the report.

D. DATA SCREENING AND ANALYSIS

1. Describe procedures used for the treatment of outliers...

See pages 15-18 of the report.

2. Describe what was done to control for the effects of ...

Changes in weather effects were incorporated, as were changes in production levels and differences in end-use specific equipment capacity among customers.

3. Describe procedures, including those identified in Table C-12, ...

See pages 15-18 of the report.

4. Regression statistics

See pages 23 -29 of the report, as well as the regression output in Appendix C and Appendix D.

5. Specification

See Conditional Demand Model Development (pages 19-29) of the report.

6. Error in measuring variables

It was not believed that measurement error presented a significant problem for this analysis with the exception of customer specific production data. The lack of monthly production data for the majority of participants increased the error bounds on the savings estimates.

7. Autocorrelation

See page 23-27 of the report. Serial correlation was found. The second stage of the regression analysis addressed this issue.

8. Heteroscedasticity

See pages 25 and 27-29 of the report. Heteroscedasticity was found. The third stage of the regression analysis addressed this issue.

9. Collinearity

Collinearity was not believed to be a significant problem with the chosen model specification. (See the correlation matrix in Appendix B)

10. Influential data points

Outliers were not believed to be a problem given that inconsistency and consumption history screens that were employed (see pages 15-18) A less restrictive model was developed that employed outliers; the savings estimates were consistent with the preferred model, but the savings were not statistically different from zero.

11. Missing data

See pages 15-18 of the report.

12. Precision

The conditional means of the average equipment capacity were employed to simulate usage pre and post audit. Confidence intervals for the savings estimates were determined using the standard error of the regression.

E. DATA INTERPRETATION AND APPLICATION

1. For all program participants and at the end use level, ...

Net impacts were calculated by using the conditional demand model to predict monthly consumption. First, customers participating in the audit program had annual appliance energy use values calculated for the following scenarios:

a) no audit conducted

b) post audit (with saturation of gas-using equipment determined as sample-weighted averages from the analytic data set)

Next, customers in the comparison group had usage estimated assuming no audit was conducted in both scenarios. Monthly weather conditions, as well as other customer characteristics taken from the survey, are held constant throughout all the scenarios for all survey customers. The space heating usage estimates are based on average monthly weather conditions over the past 30 years in the Gas Company weather zones weighted for program participation. This approach permitted the differences in equipment usage among the scenarios to truly reflect the therm savings attributed to the audit.

2. Describe the process, choices made, and rationale for ...

This is the tradition approach employed when using a conditional demand model to determine impacts.