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CHARACTERIZATION OF ALLERGEN EXPOSURE IN HOMES

by

Debye Galaska, CIH

Essay

Submitted in partial fulfillment of the requirements
for the degree of Master of Health Science
at the Johns Hopkins University
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ABSTRACT

Environmental sampling for allergen quantification is a relatively new field of endeavor. Current evaluations focus on surface sampling with vacuum devices using a variety of collection filters. In the allergy field, results have conventionally been reported in terms of a mass of antigen per a mass of "total dust" which varies in definition between analytical laboratories. Many of the sample protocols encourage composite sampling of many potential allergen sources to characterize an entire house.

Allergen levels were measured in 41 surface samples, and units of surface concentration of mass of antigen per total sieved dust, mass of antigen per unit area, and mass of antigen per unit area times sample collection time were compared. For dust mite antigen Der f 1 there was low correlation between units of surface concentration. Correlation between units for cat antigen Fel d 1 was strong. However, the more conventional unit of mass of antigen per unit area is demonstrated to be a more meaningful measure of reservoir potency. The impact of collection time and the appropriate way to incorporate it into measurements requires further study.

This study shows that there is a significant difference between antigen content of various reservoirs, such as carpets, sofas or chairs, and mattresses. There is also evidence to suggest that sample collection time, surface characteristics, and food sources should be explored further to establish whether they impact allergen levels.

Air samples were collected and compared to surface sample results. There was no correlation between surface levels of Fel d 1 and airborne levels. All but one of the results for Der f 1 air samples were below the limit of detection, indicating only that very large volumes, in excess of 22 cubic meters, are required to achieve detectable levels by present analytical methods.

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1. Introduction.

Allergy is a significant health problem for millions of Americans; with an estimated 35.3 million people affected in 1975.¹ Allergy complaints were second to dental conditions as the most frequent medical complaint.¹ Dust mite and cat allergies are common and result in symptoms year-round. Important allergens are those that efficiently deposit in the naso-pharyngeal region, where the immune system can recognize them and trigger a response.² Therefore, in assessing patient risks and the efficacy of protective measures, it is important to quantify the amount of airborne allergen that may reach the patient's naso-pharynx resulting in an allergic response.

The purpose of this research was to evaluate surface and air sampling methods available for quantifying dust mite and cat dander allergens in home environments. Vacuum sampling of household surfaces is currently used to assess the magnitude of exposure to allergens in the home.^{3,4,5} Exposure is typically reported as the mass of allergen per mass of total household dust in a given sample. Exposure is then classified in broad categories as a high, medium or low risk factor.⁴ It is not always clear exactly what the total dust represents. In some cases it is not total dust but the fraction that is scraped from the sample collection medium and sieved.

This project evaluates an air sampling method used in conjunction with a currently utilized surface sampling method to determine whether the vacuum sampling technique gives a reliable indication of inhalation exposure potential. Hypotheses tested include:

1. Surface samples as reported in nanograms of allergen per gram of total dust (ng/g) do not correlate with airborne allergen and, therefore, do not predict inhalation risks.

2. Surface samples as reported in ng/g do not correlate with surface

samples results in more conventional surface sampling terms of mass of allergen per unit area.

3. Surface sample collection time, using current sampling protocols, is important to consider in evaluating surface sample results.

4. Factors such as food consumption, type of surface (sofa, chair, mattress, etc), qualitative characteristics of the surface (loose or tight weave, deep or short pile, etc), level of activity, and time since a pet was last in the room may affect allergen levels in the surface and/or in the air.

II. Background.

A. The Nature of the Allergens. In this study the two major year-round allergens are evaluated, house dust mite and cat allergens. The major house dust mites producing allergens are Dermatophagoides farinae (Der f) and Dermatophagoides pteronyssinus (Der p). In particular, the allergens analysed for are referred to as Der f I and Der p I. The major cat allergen is referred to as Fel d I.

1. House-Dust Mite.

House dust is a complex mixture which contains a number of potential allergens, including house dust mites (living, dead, parts, and excreta), animal products (danders, saliva, and other proteins), fungi, algae, human skin scales, food debris, and decaying plant fibers.¹ In 1964 the house dust mite was identified by Voorhorst et al as the most important allergenic source within the generic house dust mixture.⁶ Dust mite allergens have been associated causatively with asthma, atopic dermatitis, and rhinitis.⁷ Studies from several countries, reviewed by Platts-Mills et al, demonstrate that asthmatic individuals have a higher prevalence of dust mite sensitivity than do non-asthmatics (45 to 85% prevalence as compared to 5 to 30% in controls). The reviewers interpret these consistent findings as a strong indicator that dust mite allergy is a risk factor for

asthma.⁷ Thus, there has been a keen interest in characterizing the exposure levels found in various settings, quantifying and assessing potential risk from various exposure situations, and determining ways to reduce the risks.

The house mite was first identified by van Leeuwenhoek in 1694; since then over 50,000 species of mites have been identified.¹ The house dust mite has a three month life cycle, going through egg, larval, protonymph, tritonymph, and adult stages.^{8,9} The Pyroglyphoid family and, in particular, members of the the genus Dermatophagoides have been identified as a constituent of house dust by Baker in 1954. Specifically D. farinae and D. pteronyssinus are implicated as major sources of allergens, although others may be allergenically important to a lesser degree.¹

Tovey et al³⁴ attempted to isolate the component of the dust mite which contains the allergen. They characterized mite allergic activity by quantifying Der p 1 (Dermatophagoides pteronnyssinus 1), an antigen with molecular weight of 24,000 Daltons. Der p 1 is a major allergen by virtue of the fact that up to 75% of immunoglobulin E (IgE) antibodies to mites have been found to be directed against it. Tovey et al separated these components of a mite culture and analyzed them for antigen. Eggs were found to contain very little Der p 1, but whole mites, their feces and cuticles contained 3 to 185 nanograms (ng) of Der p 1 per 100 components (3 to 12, 29, and 75 to 185 for feces, cuticles, and whole mites respectively). From these data, the investigators calculated, by assuming a mite produces 20 fecal particles per day and sheds 3 cuticles over a three month lifetime, that, within a month, feces would have generated over 95% of Der p 1 present in culture. Additionally, the nature of the allergic response requires that the important allergenic components would have to elutriate rapidly in saline solution, because particles in the nasal mucosa would be cleared within 10 minutes of deposition.⁹ Whole mite bodies do not

elutriate in a 16 hour period, whereas feces, mite culture, and house dust elutriate nearly 100% within 3 to 10 minutes. Fecal particles are numerous; they are spheroid, smooth surfaced particles ranging from 10 to 40 micrometers (um) in diameter; and they elutriate rapidly in saline; therefore, they are thought to be the most significant component.⁹

There are numerous conflicting views of where dust mites prefer to live.^{1,7,8,10} Most authors agree that optimal proliferation conditions include high humidity, although the specific "best" humidity varies by source. Table 1 lists the relative humidity conditions for mite growth reported in the literature.

TABLE 1
IDEAL RELATIVE HUMIDITY FOR MITE GROWTH

<u>Author</u>	<u>Ideal Relative Humidity(RH)</u>
Wedner ¹	more than 75%
Kang ¹⁰	75 to 80% RH (with almost no live mites below 40% RH)
Kaplan ⁸	RH over 70% (no egg laying below 60%)

Some authors state that there is an ideal temperature range, listed in Table 2, for mite growth.

TABLE 2
IDEAL TEMPERATURE FOR MITE GROWTH

<u>Author</u>	<u>Ideal Temperature</u>
Platts-Mills ⁷	17 to 25° C
Wedner ¹	22 to 30° C
Kaplan ⁸	above 25° C
Kang ¹⁰	optimum of 25° C

While the exact optimum temperature and humidity are difficult to

specify precisely, there is general agreement on a need for local warmth and moisture for some portion of the year. Short periods of dryness can be survived, as evidenced by studies of seasonal variation of mite populations. Tilak reports observing a higher population in the rainy season versus the dry season in India¹¹. Platts-Mills et al observed a 5 to 20 fold increase in dust mite populations with rising humidity in Virginia.¹² A study in Ohio by Arlian et al showed highest mite density in humid summer months and lowest density in the dry heating season¹³. Murray and Zuk found a significant correlation between number of live mites and relative humidity in Vancouver, Canada¹⁴. Further, Mosbech et al conducted a controlled study using electric heating blankets as a potential control measure for at least 12 hours per day to decrease the local relative humidity. This study showed a median reduction in mite concentration of 60% in mattresses which were infested at the beginning of the study.¹⁵ Korsgaard lists several other studies showing the influence of humidity on mite populations.¹⁶

A food source is also required for mite proliferation. The principal food source for house dust mites is thought to be human dander, with secondary sources including animal or bird dander, grain or other food dust, pollen, and fungal spores.¹ Van Bronswijk found pollen, spores of microorganisms, fungal mycelia, bacteria and fibers of plant origin (speculated to be from cotton bed sheets) in the alimentary canals of several hundred D. pteronyssinus mites, concluding that dependence on human skin scales is not as strong as other investigators have asserted.¹⁷

Carpets, upholstered furniture, and mattresses are generally found to be the major reservoirs of dust mites and/or mite antigens. There is no consistency between studies as to rank order of these major reservoirs. This is due in part to the different methods of determining the mite concentrations. Some investigators counted mite bodies from dust samples, and some performed analysis of dust samples for allergen quantity. There

are also variations between furnishings, carpeting, air conditioning, and other factors that could account for lack of a consistent ranking.

Tovey et al found bed dust (mattresses and bedding) to be the richest reservoir, with significant populations also present in carpets, furnishings, clothing and soft toys. They did not find populations on hospital and school floors (presumably uncarpeted, frequently washed surfaces).⁴ Platts-Mills et al found in their central Virginia study that sofas harbored the largest Der p 1 reservoirs, followed by bedding, then carpets. The authors suggest that a difference in air conditioning, and thus in humidity, in different rooms may be the true explanation for higher sofa content in this study.¹² Arlian et al found, in most of the homes studied, that the highest mite populations were on the family room carpet, followed by family room couch, bedroom carpet, and lastly the mattress. Long pile carpets were found to be the most heavily infested flooring, with short pile carpets and tile or wood floors having significantly lower mite populations. A wide variation within homes, indicating that sampling at several sites within a home may be required before determining whether the home is low risk for those with mite allergies, was also noted.¹³ Chang, studying homes in Taiwan, found mite populations in couches, mattresses, or bedroom or livingroom carpets did not differ.¹⁸ Van Bronswijk studied cottages in The Netherlands occupied by asthmatic children, and inferred that mattresses and fabric covered furniture act as reservoirs for dust mites, from which floors can be reinfested periodically.¹⁷ Study cottages were not carpeted, however.¹⁷

Platts-Mills et al assert that mites move away from the surface of furniture as drying occurs, so that the number of live mites counted in a surface sample may not be indicative of the quantity of allergen in the surface dust.¹² In contrast, van Bronswijk studied a mattress in cross section that was used for 12 years and found that dust had penetrated only

12 millimeters (mm) in the center and 6 mm at the sides. He alleges that the mites live only in the surface layer of the mattress.¹⁷ This is the only published evaluation a mite reservoir in cross-section to see how far the infestation penetrated.

The Dermatophagoides family have a few natural predators, which include the arthropods Cheyletidae and Gamasina. These two have been found in conjunction with Dermatophagoides during surface sampling for whole arthropods.^{17, 19} Few studies have actually looked for these predators to determine whether they significantly alter the Dermatophagoides populations, however.

It can be concluded, therefore, that the extent of dust mite infestation is likely to be due to many factors including characteristics of furnishings and floor coverings, temperature, humidity, and the presence of a food source.

2. Cat Allergens.

Cat allergen 1 (Fel d 1) is thought to be most often involved in human allergy.²⁰ Cat albumin and cat saliva also elicit allergenic activity, but to a lesser degree.²⁰

Cat allergen generation is more clearcut than for dust mite allergen. The source is obvious; however, important observations about accumulation of the allergens can be made.

Ohman et al collected surface samples throughout homes with cats and attempted to correlate observed concentrations to patterns of cat occupancy. They found higher concentration of cat allergen in areas where cats spend the most time. However, areas from which cats were totally excluded contained measurable quantities of cat allergen, indicating that allergen can be carried around on persons and/or spread through air currents. Also of considerable interest is the observation that areas of frequent cat occupancy, such as sleeping areas on rugs or furniture, contained many

times the amount of allergen that could be washed off a cat (6300 to 20000 units on surface compared to 270 units washed off a single cat). This indicates that cat allergen progressively accumulates in some surfaces. The authors point out that Fel d 1 is very stable, and could remain in the environment for long periods of time, maintaining allergenic potency.²¹

The persistence of Fel d 1 in home environments is further corroborated in a controlled study by Wood et al in which cats were removed from several homes and surface samples were collected over a several month period. In homes where a cat was removed, the median Fel d 1 content declined to the upper 95% confidence limit of the control homes without cats at 23 weeks after cat removal (with regular vacuuming and routine cleaning).²² In another study of 106 homes in the Baltimore area, 100% of homes had detectable cat allergen. In homes without cats in residence the levels ranged from 2 to 7500 nanograms per gram of dust (ng/g).³

B. Allergen Quantification.

Quantification of allergen in the environment is of interest for several reasons. First, there is interest in establishing whether a dose-response relationship exists between allergen exposure and the development of allergy symptoms. A clear dose-response relationship between allergen concentration and allergic response is asserted by Korsgaard. This controlled study showed a pattern of relative risks for allergic disease exceeding 1.0, when comparing higher to lower dust mite exposure categories. Much higher concentrations of house-dust mites were found in dust from the D pteronyssinus sensitive asthma patients' homes than in dust from control homes.²³ This finding has yet to be replicated, however.

Another use of precise allergen quantification would be for identifying sources of allergen and their relative contribution to potential risk. Quantification would also allow valid comparisons in assessing

avoidance type control measures, such as removing carpeting or other suspected reservoirs, frequent vacuuming, removing cats, etc.

Due to the difficulties in quantifying airborne allergen concentrations, surface sample collection techniques have been developed. Such results may be reported as a number of live and/or dead mites per mass of collected dust or as a mass of allergen per mass of collected dust. Complicating comparisons between studies looking to find a dose-response relationship, is the plethora of different analytical methods used to quantify allergen content, the variety of surface dust collection methods, the variable nature of the denominator portion of the concentration reported (usually total dust), and the unanswered question of whether a surface sample accurately describes the potential dose.

To illustrate, a study by Ishii et al demonstrated that the average number of mites in floor dust in homes of children in Tokyo did not differ between asthmatic and non-asthmatic children when compared on a mites per gram of dust basis, but did differ significantly between skin test positive and negative children when compared as mites per square meter of floor.¹⁹ Another study,³ of 106 homes in Baltimore, using mite antigen and cat allergen quantification in terms of ng/g of total dust, found no difference between homes of skin-positive and skin-negative patients or between homes with and without asthmatics.³ Chang and Hsieh studied homes in Taiwan reporting surface concentration in terms of mites per mass of dust. This study also showed no difference between houses of "normals" and mite-allergic asthmatics. Additionally, they found no relation between the number of mites in the dust and the allergenicity of the dust.¹⁸

Platts-Mills et al proposed a broad categorization of dust mite allergen concentration in terms of ng/g of total dust, stating that 10,000 ng/g of Der p 1 is commonly associated with symptoms in mite-allergic persons, and that these levels be regarded as "high". Further breakdowns include:

levels between 2000 and 10000 ng/g should be considered as "significant"; levels below 2000 ng/g, as "low"; and levels below 400 ng/g, as "very low".
3,12

Studies which have sought to define a possible dose-response relationship between allergen exposure and various allergic responses are fraught with difficulties in interpretation due to the wide variety of allergen quantification methods. Conclusions about whether past studies have either suggested or negated a dose-response relationship are therefore difficult to draw.

C. Previous Air Sampling Studies.

There are very few published dust mite and cat allergen air sampling studies. The American Conference of Governmental Industrial Hygienists guidebook on air sampling instruments refers to sampling methods for aero-allergens as at a "research level" due to the difficulty of sample analysis. Large air sample volumes are needed due to the low levels of airborne antigen generally present. Concentrations tend to vary logarithmically both spatially and temporally.²⁴ There are two basic analytical methods for allergen quantification: microscopic identification and counting, and immunological assay techniques. Six air sampling studies in the published literature are discussed below.

1. Tovey et al studied airborne antigens in asthmatic patients' homes, collecting dust on glass fiber filters using flow rates of 17 liters per minute (lpm) for short term sampling and 3.4 lpm for longer overnight sampling. A cascade impactor operated at 17.5 lpm was also used for size selective sampling. Dust extracts were analyzed by double antibody inhibition radioimmunoassay. Air sample filters were eluted in a glass tube prior to analysis.

Dust mite antigen was not detected under undisturbed conditions in the two hour or overnight samples. The only time Der p 1 allergen was detected

was when the rooms were actively disturbed with activities such as bed-making, shaking each piece of bedding, and vacuuming the bedding, mattress and floor. Disturbed condition sample periods were 45 minutes in length at 17 lpm. Airborne concentrations ranged from less than 0.392 to 39.22 ng/m³, with most being in the 1.31 to 5.23 ng/m³ range. The authors noted little correlation between the allergen concentration in the air of disturbed rooms and the concentration of allergen on the floor or in bed dust. Surface dust concentrations were expressed as ng of allergen per gram of sieved dust. (Surface results were not available in terms of mass per unit time or area.)

Particle sizing was conducted using a cascade impactor. Seventy six to 100% of the Der p 1 mass was collected on the greater than 6 micron stage; up to 14%, on the 2 to 15 micron stage; and little or none detected (average 4.5%) on the smaller stages. Sample times were less than 10 minutes at a rate of 17.5 lpm.⁴

2. Sakaguchi et al collected air samples during disturbed and undisturbed conditions using 37 mm glass fiber filters at a flow rate of 6 lpm. Sampling periods during undisturbed conditions were from 109 to 124 hours, resulting in sample volumes of 39.2 to 44.6 m³. Disturbed condition samples were collected during and after 5 to 10 minutes of bedmaking, for 40 minute periods. Filters were extracted on a shaker and in an overnight cooling, then centrifuged. The supernatant was lyophilized then reconstituted to achieve a lower limit of detection by concentrating the allergen. Allergens were measured by radioimmunoassay.

Undisturbed Der I (farinae and pteronysinus) levels were between 0.0076 and 0.116 ng/m³, with a geometric mean of 0.029 ng/m³. During the disturbed condition sampling, levels increased approximately 1000 fold, to 7.9 to 265 ng/m³. Floor allergen levels were computed as ng of allergen per gram of fine dust. There was no correlation between airborne concen-

trations and surface contamination on the quilts.⁵

3. Cunningham and Gregory collected air samples with a 15 cm diameter cyclone operated at intake velocities of 300 and 1900 cm/sec. Flow rates were 400 lpm and 3000 lpm. A series of daily samples were collected during bedmaking, including turning the mattress, and for 5 to 15 minutes afterward. These samples were examined microscopically, counting mite bodies. D. pteronyssinus mites were observed at 0.04 to 0.34 mites per cubic meter in bedrooms. None were detected in a hospital ward. A dramatic decrease in number of mites was noted after regular vacuuming of a mattress was performed. No surface concentration information is available.²⁵

4. Air samples were collected by Swanson et al with polytetrafluoroethylene filters for 24 hour sample periods at 200 lpm. Surface samples were collected directly after air sampling by vacuuming a standard surface area for a standard collection time. Air samples were incubated in wells. The wells were washed and two-site monoclonal antibody assays were conducted to analyze for antigen. Additional analyses were conducted with a two-site radioimmunoassay and RAST-inhibition assays to compare the methods. Rank order between the methods was consistent, but absolute results varied with the method, with the rabbit polyclonal two-site assay yielding much higher values than other assays in settled dust, and the IgE RAST-inhibition assay giving much higher values in airborne dust.

Air concentrations of Der p 1 were less than 0.4 to 63.6 pg/m³. Der f 1 airborne levels ranged from less than 0.4 to 78.2 pg/m³. The investigators concluded that air and surface dust concentrations correlated only for Der p 1 measured in the bedroom and mattress dust, where the correlation coefficient was 0.84. Other air versus dust correlation coefficients were 0.18 for Der p 1 in livingrooms, 0.37 for Der f 1 in bedrooms, and 0.06 for Der f 1 in livingrooms.

Fel d 1 cat allergen was also evaluated. Fel d 1 airborne levels in the bedroom air correlated with the livingroom airborne levels, but not with surface dust concentrations. There was also a correlation between airborne mite and cat allergen concentrations, indicating, according to the authors, a common dependence on ventilation rates. Fel d 1 levels ranged from none detected to 345 pg/m³, averaging 198 pg/m³ in bedrooms and 163 pg/m³.²⁶

5. Swanson et al collected airborne allergen samples using glass fiber filters and a flow rate of 180 lpm. Total dust samplers collected for 24 to 72 hours, for a sample volume of 260 to 780 m³. An Andersen cascade impactor, used for particle sizing, sampled for 48 hours collecting a volume of 3400 m³. Filters were elutriated in buffer solution. Where low concentrations of allergen were present or the larger cascade impactor filter were used, the eluate was lyophilized and reconstituted. Plate-RAST inhibition assays were done to immunochemically measure antigen.

Airborne concentrations of cat allergen were found to be proportional to the number of cats in residence, and ranged from none detected to 92 ng/m³. Airborne mite allergen (Der f) concentrations were measured from none detected to 5.57 ng/m³. Airborne levels of both cat and mite antigens were consistent throughout different rooms within a home, and both levels increased dramatically during bedmaking (to 82 ng/m³ for mite and 9,262 ng/m³ for cat).

Cat and mite allergen particle sizes were within the respirable range, with mite particle sizes between 0.8 and 4.1 microns predominating in both disturbed and undisturbed air. In disturbed air cat allergen was most concentrated two size ranges, greater than 4.1 micron and smaller than 0.8 um. Cat allergen was more evenly distributed in undisturbed air, with a preponderance in less than 0.8 um. Investigators could not ascertain

whether particle fragmentation during sampling influenced these findings.²⁷

6. Platts-Mills et al collected air samples at 17 lpm using 3 cm glass fiber filters. Particle size sampling was also conducted using a cascade impactor in which the discs were coated with an agarose, borate-buffered saline, bovine serum albumin solution. Sampling was conducted in two enclosed rooms, into which dust containing Der p 1 was artificially introduced. Antigen was measured by inhibition radioimmunoassay.

Vacuum cleaner bag dust containing antigen concentrations of 13,000 to 200,000 ng/g were aerosolized in the rooms either by manual disturbance or using a vacuum cleaner without a filter.

Experiments were conducted to evaluate the particle size distribution of mite allergen in the air and the decrease in airborne concentration after a disturbance. Results indicate that less than 4% (mass) of allergen remained airborne 15 to 35 minutes after the disturbance was created. The largest proportion of the allergen mass was collected on first stage, >10 μm , although material was present in detectable levels down to the fourth stage, 0.3 to 2.5 μm .²⁸

The artificial dust generation system may biased the findings of Platts-Mills et al, however. The vacuum cleaner bag, used as the dust source, may not collect ultrafine particles very efficiently, and may not release them as efficiently as larger particles. Therefore, the smaller particles may have been selected out of the source. The authors also do not note that while the largest mass of particles was collected on the largest size stage, this does not reflect that smaller masses on smaller stages may contain larger numbers of particles. The numbers of particles, rather than the mass, may be important for initiation of allergic response. Additionally, there is a large disparity between the mass collected in the impactor and the mass collected on parallel filters that is not explained.

III. Methods.

A. Description of Sample Sites.

Homes were selected for airborne and surface antigen sampling based on the ease of access by the investigator. Each sample home required extensive sampling and therefore required cooperation of the homeowner. A description of each sample home is at Appendix 1.

B. Surface Sample Collection and Analysis.

Surfaces which are likely to be reservoirs for the antigens under study were initially investigated to identify homes with elevated surface antigen levels. Surfaces sampled include carpets, mattresses, upholstered furniture, and pillows. Homes with elevated surface antigen levels were re-visited to evaluate airborne antigen concentrations.

The surface samples were collected using a vacuum cleaner equipped with a vacuum sampling head provided by the Johns Hopkins Medical Institutions Reference Laboratory for Dermatology, Allergy & Clinical Immunology (DACI) analytical laboratory. The same vacuum cleaner, a Eureka cannister, was used each time with a fresh empty bag and unused filter. The sampler is an upholstery type attachment with a Whatman paper filter, pore size 11 μ m, placed inside a perforated plastic petri dish.

Samples were vacuumed from surfaces of known area for a known time period, with sample area and duration estimated in order to collect enough dust for an easily analyzed sample and completely cover the surface within the chosen boundaries. Previous experience of the laboratory analyzing these samples indicated that an 8 minute vacuum sample will generally provide sufficient mass for analysis. Collection times of 8 minutes, where feasible, were therefore employed. The vacuum attachment was moved slowly in close contact with the surface being sampled. The attachment was inverted at the conclusion of sampling to prevent loose material, and a labelled cover was placed on the petri dish. The dish was immediately

enclosed in a small zip-lock plastic type bag. Sample collection information was recorded on the Vacuum Sample Form (Appendix 2) and the sample was transmitted to the laboratory for analysis.

Analysis was conducted by the DACI Laboratory of the Johns Hopkins Medical Institutions. Collected material was scraped from the filter and forced through a 50 mesh sieve onto weighing paper. The dust was then weighed to the nearest milligram. One hundred mg of the sieved dust was transferred to a vial for analysis. Following the procedure described by Chapman et al,²⁹ samples were extracted overnight in 2 ml of borate-buffered saline and centrifuged. The supernatant is analyzed for allergen content.

Der f 1 and Der p 1 antigen enzyme immunoassays were conducted using procedures described by Chapman.^{30,31} The sample is placed into microtiter wells containing a buffer solution and known amount of monoclonal antibody. Enzymatic reactions are stopped by addition of sodium azide, and results are evaluated in an ELISA microtiter plate reader. Standard dilutions of 1:5, 1:25 and 1:125 are used, and followed by higher dilutions if necessary. Results are reported in nanograms of antigen per gram of sieved dust (ng/g).

Fel d 1 cat allergen is extracted and analyzed using a similar technique with a monoclonal antibody procedure described by Chapman et al^{32,33} Sample is added to microtiter wells containing buffer solution and a known amount of antibody. An ELISA microtiter plate reader is used to obtain results at at least two dilutions.

C. Air Sample Collection and Analysis.

Air samples were collected using a high volume vacuum pump, critical orifice, and 37 mm glass fiber filters in a closed face cassette. The filters were removed from the cassettes after sampling, rolled with the

collected dust to the interior, and placed into the analysis vial with tweezers. This enabled the use of less elutriant.

Initially a few 24-hour samples were collected at a flow rate of 14.75 lpm to determine the minimum sample volume needed to provide sufficient antigen for analysis. Detectable quantities of Der f 1 and Fel d 1, were observed in the samples, even where surface samples from the same area were low. It was therefore concluded that, where possible, 24-hour samples should be collected, yielding sample volumes around 10 m³. In some situations, high activity levels or excessive pump noise necessitated shorter sample periods. Air sample collection parameters were recorded on the Air Sampling Form at Appendix 3.

The limit of detection on air sample filters, using a slightly modified analytical technique from that used for surface sample dust to increase sensitivity, is estimated to be approximately 0.4 nanograms of antigen per filter.

D. Evaluation of Homogeneity of Collected Surface Dust.

The variability of antigen levels within a previously characterized surface dust sample was evaluated. It was thought that, if sufficiently homogenous, this material could be used as a "known" antigen source to evaluate air sample analytical procedures. A bulk dust, collected from a vacuum cleaner bag, was analyzed by the DACI Laboratory and found to contain 914 ng/g of Der f 1. In the laboratory, this bulk sample was deposited onto two air sample filters by dropping a quantity of the characterized dust onto glass fiber filters while a pump was drawing air through the filter. These samples are referred to as spiked filter samples. The sample cassette was rotated and gently agitated to evenly disperse the dust. Sufficient quantities were added to provide antigen levels in excess of the reported quantification limits.

During this procedure the larger grains of dust, plainly visible, did

not adhere to the filter. The bulk dust was then placed in a Number 70 (212 micron opening) sieve and shaker to further separate larger particles from smaller. Two bulk samples of the larger dust, and three of the smaller dust from different parts of the samples were submitted to the DACI Laboratory for bulk analysis.

The sieved (<212 um) dust was then collected onto three air samples in the manner already described, and submitted to the DACI Laboratory for analysis.

IV. Results and Discussion.

A. Evaluation of Homogeneity of Collected Surface Dust.

The purpose of this evaluation is to see if a relatively homogeneous bulk sample could be obtained and used to evaluate analytical procedures by spiking samples with known quantities of allergen. The sieved bulk dust sample was originally analyzed by DACI with one sample and reported to contain 914 ng/g of Der f 1. The observation was made during the air sample test that the bulk dust did not all adhere to the filter. Therefore, the dust was sieved further, and the two fractions were studied.

The finer, sieved bulk dust was sampled three times, and sent blind to the analytical laboratory, to determine the homogeneity of the sample. Analysis of the sieved bulk dust that was believed to be homogenous showed variation between samples with a mean of 942 ng/g Der f 1, standard deviation of 260 ng/g, and range of 612 to 1247 ng/g. Results for the three samples of sieved dust (<212 um) are reported in Table 3, in nanograms per gram. Analysis for three antigens was provided by the laboratory, and are included for the information offered about variability in other antigens.

TABLE 3

PREVIOUSLY CHARACTERIZED BULK DUST - AFTER SIEVING THROUGH NO 70 SIEVE

Sample Number	<u>Der p 1</u>	<u>Der f 1</u>	<u>Fel d 1</u>
R	<50	1247	110
S	<50	612	60
T	<50	968	210
Mean	<50	942	127
S.D.	0	260	62

The coarser bulk dust, >212 um, was sampled twice. There was no antigen detected in either sample (<50 ng/g for Der f 1, Der p 1, and Fel d 1), indicating that all of the antigen is present in the finer sieved dust.

These results indicate that there is variation within what is treated as homogenous dust, that there is variation in results from the analytical method when submitted in blind samples, or both. The sieve used by the DACI laboratory leaves coarse dust in the sample which increases the mass of dust in the denominator of concentration expressions, but this dust does not appear to contain antigen, nor to be related to antigen level. This bulkier dust visually appears to be sand or similar material which could be brought into the home environment independently of antigen.

The second portion of examining the analytical method involved loading air sample filters with a known concentration of bulk dust to determine whether there is a similar concentration finding on an air sample compared to the source bulk dust.

Filter samples from the original mixed dust were expected to contain 914 ng/g of Der f 1, within lab handling and extraction variability, if the original bulk dust had both been homogenous and had adhered to the air

sample filter in the same ratio as found in the bulk material. Analysis of the spiked filter using the original bulk dust sample showed only an average of 476 ng/g on the filter, reported in Table 4. There was no Der p 1 detected.

TABLE 4

FILTER SAMPLES - ORIGINAL CHARACTERIZED BULK DUST (914 NG/G of DER F 1)

Sample Number	Mass of Collected Dust, ng	<u>Der f 1</u>		<u>Fel d 1</u>	
		<u>mass,ng</u>	<u>conc,ng/g</u>	<u>mass,ng</u>	<u>conc,ng/g</u>
F	10.023	5.2	519	0.6	60
I	8.085	3.5	433	<0.5	<62
Mean			476		
SD			43		

Spiked filter samples of the fine fraction of the sieved dust were expected to approximate the average levels found in the bulk samples, 942 ng/g and 127 ng/g of Der f 1 and Fel d 1 respectively. Much lower concentrations of Der f 1 were found on the spiked filter samples than were found in the original bulk samples, and levels of Fel d 1 expressed in ng/g were higher in the spiked filter samples. Spiked filter results are reported in Table 5. All Der p 1 results were less than 0.5 ng.

TABLE 5

SPIKED FILTER SAMPLES - DUST SIEVED THROUGH NO 70 SIEVE (<212 um)

Sample Number	Mass of Collected Dust, ng	<u>Der f 1</u>		<u>Fel d 1</u>	
		mass,ng	conc,ng/g	mass,ng	conc,ng/g
G	9.411	6.3	669	1.0	106
H	9.286	4.1	442	1.5	162
J	6.889	3.7	537	1.5	218
Mean			549		161
SD			93		46

These results indicate that the proportion of dust containing antigen on a spiked sample filter is not consistent with the proportion found in the source bulk dust. This proportion is approximately 58% for Der f 1, and 127% for Fel d 1 for this trial. Some of the variation may be due to sample losses in handling. The variability in Fel d 1 spiked filter results was much higher than in Der f 1 results, with coefficients of variation of 29% and 17% respectively. An additional conclusion is that surface antigen expressed as ng of antigen per gram of dust is not likely to provide a reliable indicator of what will be found in an air sample, even without the additional complexity of differential settling in the air. This area needs to be the focus of further research.

B. Residential Airborne and Surface Antigen Levels.

1. Vacuum Sample Results. Results are available for Der f 1, Der p 1, Fel d 1, and total dust for 41 samples. Samples were collected in 29 locations within 9 homes. Fourteen samples were collected in duplicate locations on different days. Six samples were determined by the analytical laboratory to have insufficient quantity for analysis.

The levels of the three antigens are reported following the DACI Laboratory convention, in nanograms of antigen per gram of total sieved dust. Fifty ng/g was the detection limit for the assays reported by the laboratory.

TABLE 6
VACUUM SAMPLE RESULTS
AS REPORTED BY DACI IN NG/G

<u>Sample #</u>	<u>Der f 1</u>	<u>Der p 1</u>	<u>Fel d 1</u>	<u>Total Dust</u>	<u>Site</u>
V001	767	163	97	0.328	A/BR1/futon
V013	1167	290	202	0.247	A/BR1/futon
V030*	371	278	152	0.148	A/BR1/futon
V002	1156	<50	57	0.245	A/BR1/carp
V003	118	59	997	0.227	A/BR2/futon
V029*	115	68	<50	0.145	A/BR2/futon
V004	116	<50	132	0.227	A/BR2/carp
V005	60	<50	563	0.621	A/LR/sofa
V028*	62	<50	1350	0.949	A/LR/sofa
V006	247	269	<50	0.063	A/LR/carpet
V007	<50	<50	157	0.159	A/BR3/futon
V008	<50	<50	557	0.179	A/BR3/carp
V009	54	<50	2,323,180	0.135	B/FR/chair
V010	70	<50	264,397	0.034	B/FR/carpet
V031*	213	<50	not enough	not given	B/FR/chair/r
V032*	59	<50	3,134,314	0.152	B/FR/chair/l
V011	318	592	3323	0.696	C/FR/sofa
V041*	1233	293	1051	0.3138	C/FR/sofa
V012	222	168	2281	0.099	C/FR/carpet
V042*	1657	92	461	0.2433	C/FR/carpet
V014	168	<50	97	0.338	D/BR/mattr
V037*	125	<50	514	0.040	D/BR/mattr
V015	175	<50	228	0.621	D/BR/carpet
V036*	190	<50	305	0.992	D/BR/carpet
V016	<50	<50	<50	0.886	E/LR/carpet
V017	<50	<50	207	0.083	E/LR/chair1
V018	373	<50	<50	0.322	E/LR/chair2
V035*	548	<50	<50	0.036	E/LR/chair
V019	836	<50	8,777,972	0.087	F/LR/chair
V020	5718	<50	1,830,677	0.024	F/LR/chair
V021	301	<50	613	0.068	G/LR/sofa
V044*	292	<50	298	0.4155	G/LR/sofa
V022	513	<50	229	1.302	G/LR/carpet
V023	208	<50	124	0.393	G/BR/rug
V024	205	<50	<50	0.020	G/BR/pillow
V025	20886	3882	57	0.219	H/FR/couch
V026	3183	2727	<50	0.034	H/FR/carpet
V027	201	523	<50	0.038	H/BR/bedding
V033	<50	<50	147,843	1.029	B/DR/carpet
V034*	<50	<50	114,042	0.372	B/DR/carpet

V038	not enough to analyze			I/BR/pillow
V039	976 61 <50	0.180		I/BR/matt
V040	not enough to analyze			I/BR/carpet
V043	not enough to analyze			
V045*	454 <50 <50	1.3827		G/LR/carpet
V046	not enough to analyze			
V047	not enough to analyze			

* denotes vacuum samples collected after air sampling.

House locations A-I are described in Appendix 1.

BR is bedroom, FR is family room, DR is dining room, LR is livingroom.

The total allergen in the sample was calculated, and this was used to determine surface antigen levels using units of ng/ft² and ng/ft²(min). These results are presented in Tables 7 - 9.

TABLE 7

VACUUM SAMPLE RESULTS FOR DER F 1
AS ANTIGEN PER GRAM OF SIEVED DUST, PER SAMPLE, PER TIME, AND PER AREA

Sample #	ng/g	ng/sample	ng/min	ng/ft ²	ng/ft ² (min)
V001	767	251.6	31.5	2.2	0.27
V002	1156	283.2	31.5	4.7	0.59
V003	118	26.8	3.8	1.4	0.203
V004	116	26.3	3.8	0.5	0.07
V005	60	37.3	7.5	1.0	0.20
V006	247	15.6	3.1	0.3	0.07
V007	<50	<8.0	<1.0	<0.2	<0.03
V008	<50	<9.0	<1.5	<0.2	<0.04
V009	54	7.3	1.2	0.4	0.07
V010	70	2.4	0.2	0.1	0.015
V011	318	221.3	26.0	9.6	1.13
V012	222	22.0	2.9	1.5	0.2
V013	1167	288.2	41.2	3.8	0.54
V014	168	56.8	12.6	6.0	1.33
V015	175	108.7	21.7	8.5	1.70
V016	<50	<44.3	<8.7	<3.6	<0.74
V017	<50	<4.2	<1.0	<0.5	<0.12
V018	373	120.1	24.0	18.8	3.75
V019	836	72.7	18.2	16.9	4.23
V020	5718	137.2	27.4	13.9	2.77
V021	301	20.5	4.1	1.6	0.32
V022	513	667.9	95.4	34.4	4.92
V023	208	81.7	11.7	6.4	0.91
V024	205	4.1	0.9	0.2	0.05
V025	20886	4574.0	571.8	205.1	25.64
V026	3183	108.2	27.1	9.1	2.27
V027	201	7.6	1.9	0.3	0.07

V028*	62	58.8	7.8	2.5	0.33
V029*	115	16.7	1.9	0.9	0.10
V030*	371	54.9	7.8	1.4	0.20
V032*	59	9.0	2.3	1.1	0.27
V033	<50	<51.5	<12.9	<8.6	<2.15
V034*	<50	<18.6	<4.1	<3.0	<0.68
V035*	548	19.7	2.8	3.1	0.44
V036*	190	188.5	37.7	20.9	4.19
V037*	125	5	0.8	0.3	0.05
V039	976	105.4	21.1	13.5	2.70
V041*	1233	386.9	43.0	34.2	3.80
V042*	1657	403.1	50.4	34.5	4.31
V044*	292	121.3	20.2	13.6	2.27
V045*	454	627.7	104.6	60.9	10.16

TABLE 8

VACUUM SAMPLES FOR DER P 1
AS ANTIGEN PER GRAM OF SIEVED DUST, PER SAMPLE, PER TIME, AND PER AREA

<u>Sample #</u>	<u>ng/g</u>	<u>ng/sample</u>	<u>ng/min</u>	<u>ng/ft²</u>	<u>ng/ft²(min)</u>
V001	163	53.3	6.7	0.5	0.06
V002	<50	<12.3	<1.5	<0.2	<0.03
V003	59	13.4	3.8	0.7	0.10
V004	<50	<11.4	<1.6	<0.2	<0.03
V005	<50	<31.1	<6.2	<0.8	<0.17
V006	269	16.9	3.4	0.4	0.07
V007	<50	<8.0	<1	<0.2	<0.03
V008	<50	<9.0	<1.5	<0.2	<0.04
V009	<50	<6.8	<1.1	<0.4	<0.07
V010	<50	<1.7	<0.2	<0.1	<0.01
V011	592	412.0	48.5	17.8	2.10
V012	168	16.6	2.2	1.1	0.15
V013	290	71.6	10.2	0.9	0.13
V014	<50	<16.9	<3.8	<1.8	<0.40
V015	<50	<31.1	<6.2	<2.4	<0.49
V016	<50	<44.3	<8.7	<3.6	<0.74
V017	<50	<4.2	<1.0	<0.5	<0.12
V018	<50	<16.1	<3.2	<2.5	<0.50
V019	<50	<4.4	<1.1	<1.0	<0.26
V020	<50	<1.2	<0.2	<0.1	<0.02
V021	<50	<3.4	<0.7	<0.3	<0.05
V022	<50	<65.1	<9.3	<3.4	<0.48
V023	<50	<19.7	<2.8	<1.5	<0.22
V024	<50	<1.0	<0.2	<0.05	<0.01
V025	3882	850.2	106.3	38.1	4.77
V026	2727	92.7	23.2	7.8	1.95
V027	523	19.9	5.0	0.8	0.19
V028*	<50	<47.5	<6.3	<2.0	<0.27
V029*	68	9.9	1.1	0.5	0.06
V030*	278	41.1	5.9	1.1	0.15
V032*	<50	<7.6	<1.9	<0.9	<0.23
V033	<50	<51.5	<12.9	<8.6	<2.15
V034*	<50	<18.6	<4.1	<3.0	<0.68
V035*	<50	<1.8	<0.3	<0.3	<0.04

V036*	<50	<49.6	<9.9	<5.5	<1.10
V037*	<50	<2	<0.3	<0.1	<0.02
V039	61	6.6	1.3	0.8	0.17
V041*	293	91.9	10.2	8.1	0.90
V042*	92	22.4	2.8	1.9	0.24
V044*	<50	<20.8	<3.5	<2.3	<0.39
V045*	<50	<69.1	<11.5	<6.7	<1.12

TABLE 9

VACUUM SAMPLES FOR FEL D 1
AS ANTIGEN PER GRAM OF SIEVED DUST, PER SAMPLE, PER TIME, AND PER AREA

<u>Sample #</u>	<u>ng/g</u>	<u>ng/sample</u>	<u>ng/min</u>	<u>ng/ft²</u>	<u>ng/ft²(min)</u>
V001	97	31.8	4.0	0.3	0.03
V002	57	14.0	1.8	0.2	0.03
V003	997	226.3	32.2	11.9	1.70
V004	132	30.0	4.3	0.6	0.08
V005	563	349.6	69.9	9.3	1.86
V006	<50	<3.2	<0.6	<0.1	<0.01
V007	157	25.0	3.1	0.7	0.08
V008	557	99.7	16.6	2.5	0.42
V009	2,323,180	313,629.3	52,271.6	18,340.9	3056.82
V010	264,397	8,989.5	899.0	266.0	26.60
V011	3323	2,312.8	272.1	100.1	11.78
V012	2281	225.8	30.1	15.5	2.06
V013	202	49.9	7.1	0.7	0.09
V014	97	32.8	7.3	3.5	0.77
V015	228	141.6	28.3	11.1	2.21
V016	<50	<44.3	<8.7	<3.6	<0.74
V017	207	17.2	4.3	2.0	0.49
V018	<50	<16.1	<3.2	<2.5	<0.50
V019	8,777,972	763,683.6	190,920.9	177,600.8	44,400.21
V020	1,830,677	43,936.2	8,787.2	4438.0	887.60
V021	613	41.7	8.3	3.2	0.64
V022	229	298.2	42.6	15.4	2.20
V023	124	48.7	7.0	3.8	0.54
V024	<50	<1.0	<0.2	<0.05	<0.01
V025	57	12.5	1.6	0.6	0.07
V026	<50	<1.7	<0.4	<0.1	<0.04
V027	<50	<1.9	<0.5	<0.1	<0.02
V028*	1350	1281.2	170.8	53.8	7.18
V029*	<50	<7.3	<0.8	<0.4	<0.04
V030*	152	22.5	3.2	0.6	0.08
V032*	3,134,314	476,415.7	119,103.9	58099.5	14524.87
V033	147,843	152,130.5	38,032.6	25355.1	6338.77
V034*	114,042	42,423.6	9,427.5	6954.7	1545.49
V035*	<50	<1.8	<0.3	<0.3	<0.04
V036*	305	302.6	60.5	33.6	6.72
V037*	514	20.6	3.4	1.1	0.19
V039	<50	<5.4	<1.1	<0.7	<0.14
V041*	1051	329.8	36.6	29.2	3.24
V042*	461	112.2	14.0	9.6	1.20

V044*	298	123.8	20.6	13.6	2.32
V045*	<50	<69.1	<11.5	<6.7	<1.12

There were several issues to examine concerning the vacuum sample results. The first issue relates to the selection of appropriate vacuum sample surface concentration terms. The concentration term used in the allergy field of ng of antigen per gram of sieved collected dust did not seem to be most appropriate for reasons already discussed in the analytical method section. The mass of dust in a given area does not appear to be a relevant or consistent denominator with which to characterize allergen concentration in a given source. The standard industrial hygiene concentration term for surface samples is to express them in terms of mass per unit area. This term offers the advantage of quantifying allergen within a defined space, so that predictions could be made regarding the consequences of disturbing a particular area. A third term was evaluated to attempt to take into account an important aspect of surface sampling by vacuum; the time of contact with the relatively complex surfaces of upholstery or carpet within a given area has an impact on how much antigen is collected. Increased time in an area will increase collection, within limits.

A total of 41 samples were collected with sufficient dust for analysis. The samples were collected by trying to evenly cover the surface area in one pass. Linear regression was performed to see if there was a relationship between sample area and collection time. The mean collection time in this set of samples was 6.2 ± 4 minutes. The mean collection area was $23.1 \pm 4.3 \text{ ft}^2$. The collection time and area were weakly but significantly correlated ($r = 0.383$, $p < 0.05$). Presence of a cat, surface type (carpet, sofa/chair, or mattress), and a subjective scalar rating of the trapping ability of a surface were all significant factors in this relationship. Other factors that were beyond the scope of this project may also affect the time required to sample a surface. (See Appendix 4.) This analysis indicates that it may be important to consider both the sample area and

collection time in evaluating the significance of vacuum sample results.

Histograms of Der f 1 and Fel d 1 surface sample results are presented in Appendix 5. Arithmetic and geometric means and standard deviations of the sample sets for the various concentration units studied are in Tables 10 and 11. The raw surface sample data, in all units, are very skewed; when logarithms are taken, the data appear to approximate a normal distribution. Fel d 1 data were clearly bimodally distributed. The presence or absence of a cat in the house was taken into account in further analyses.

TABLE 10

DER F 1 VACUUM SAMPLE CHARACTERISTICS - 41 SAMPLES

Concentration Term	Arithmetic Mean	Arithmetic SE	Geometric Mean	Geometric SE
ng/g	1056	25	239.1	25.00
ng/filter	226.3	2.075	46.9	2.08
ng/ft ²	13.43	0.0704	2.78	0.070
ng/ft ² (min)	2.044	0.00704	0.466	0.00704

*For these presentations, values of 0.5 of the limit of detection were used for calculating means and standard deviations.

TABLE 11

FEL D 1 VACUUM SAMPLE CHARACTERISTICS - 41 SAMPLES

AGGREGATE DATA - ALL HOMES				
Concentration Term	Arithmetic Mean	Arithmetic SE	Geometric Mean	Geometric SE
ng/g	405042	25.00	665.81	25.00

DATA FOR HOMES WITH CAT PRESENT				
Concentration Term	Arithmetic Mean	Arithmetic SE	Geometric Mean	Geometric SE
ng/filter	257316	8989	117008	8991
ng/sf	41579	266.0	12161	265.9
ng/sf*min	10111	26.60	2397.1	26.60

DATA FOR HOMES WITHOUT CATS				
Concentration <u>Term</u>	Arithmetic <u>Mean</u>	Arithmetic <u>SE</u>	Geometric <u>Mean</u>	Geometric <u>SE</u>
ng/filter	183	1	32.14	0.5
ng/ft ²	10	0.0	1.697	0.025
ng/ft ² (min)	1	0.01	0.276	0.0055

The surface sample data were then examined for a relationship between antigen mass per sample and sieved dust per sample. Taking the logarithms of the antigen and dust quantities was necessary for performing linear regression; this resulted in more bell-shaped residuals.

For Der f 1 there was a significant, though not strong, relationship between the total sieved antigen and the total sieved dust collected on the filter ($r = 0.49$, $p < 0.05$). Plots and statistics are in Appendix 6. This further strengthens the notion that there is no intrinsic relationship between the quantity of dust in a vacuum surface sample and the quantity of Der f 1 antigen. Clearly there is even less relationship for Der p 1, which had too many non-detectable results for good statistical analysis.

The 95% confidence limits of the regression slope for surface sample mass of Fel d 1 and corresponding total sieved dust overlapped zero, indicating no significant relationship, when no factors were present in the model. When the factor of cat presence or absence was added to the model, there was a significant relationship between the two quantities ($r = 0.93$, $p < 0.05$). See Appendix 7 for details of this statistical analysis.

Thus, the mass of dust present in a sample is not a reliable indicator of the amount of Fel d 1 allergen present, unless some accounting is made for the presence or absence of a cat. The mass of Der f 1 is weakly related to the mass of dust in the analyzed sample, and without further elucidation of other relevant factors is not a good predictor of allergen presence by itself.

Analyses of variance were conducted with surface sample Der f 1 results to tentatively explore the impact of some factors on the levels of antigen found in the 41 vacuum samples analyzed. There are a multitude of factors that may potentially impact the level of antigen present. A few pertinent factors were identified that are important to levels of antigen present. These include type of surface, the trapping ability of the surface for dust retention, consumption of food, and presence or absence of a cat in the home.

The type of surface was classified as carpet, sofa/ chair, or mattress. Whether the surface was carpet was a significant factor in this sample set. The mean for carpet was 21.52 ng/ft², with standard error 7.610 ng²/ft⁴, with means in sofa/chair of 9.342 ng/ft² and in mattress of 3.549 ng/ft². Carpets were also highest when units of ng/ft²(min) were used. As discussed in the Background Section, different studies have had different findings as to the most potent reservoirs of allergen. Carpets contained the highest levels of Der f 1 in this study; beds, sofas, and carpets have each been identified as the most potent reservoir in various other studies. Therefore, there must be other factors, aside from the fact that the item studied is a carpet or bed or sofa, about the sources that make them preferential allergen reservoirs.

Areas where food consumption took place on more than a rare occasion (more than once a month) showed a statistically significant increase in Der f 1. This is consistent with previously cited studies which state that mites use both human dander and human foodstuffs as food sources. Surfaces were also subjectively rated on a scale of 1 to 3 as to their trapping ability. This assessment took into account parameters such as thickness of weave, depth of carpet pile, and thickness of underlying material if dust could readily penetrate to underlying material. High trapping ability (rating of 3) of a surface was significantly associated with higher levels

of antigen. In this particular group of sample sites, the highest antigen levels occurred where there was a trapping rating of 3 (highest), carpet, and food consumption more than once a month. The absence of a cat was also associated with higher Der f 1 levels. From discussion with the various residents, the cat-owners in this group seemed to vacuum more frequently than the non-pet owners. (See Appendix 8.)

Similar analyses of variance were conducted for Fel d 1 presence. In this sample set there was an overall trend for highest antigen level in the sofa/chair category, most likely because the cats in this study used chairs as their favorite napping location. Nearby carpet was consistently lower in antigen content, and the one carpet napping area was lower than the chairs. High trapping ability rating and presence of a cat interacted to also result in high Fel d 1 levels in this sample of sites. As expected, there was no relationship between cat allergen and the consumption of food by human occupants. See Appendix 9 for details of statistical analysis.

To additionally characterize the dust collected, the total Der f 1 collected on each filter was compared to total Fel d 1 collected on that filter. As expected, there was no correlation between dust mite and cat allergen, unless the presence or absence of a cat was added to the model. With that factor added, there was a weak but significant correlation ($r = 0.41$, $p < 0.05$). See Appendix 10 for details of statistical analysis.

These results indicate that presence or absence of a cat must be taken into account when evaluating surface antigen quantity. Other factors which require more precise definition may also be important. It appears that food consumption and factors that make reservoirs attractive may be important to evaluate the allergenic potential of an environment. These factors may include microenvironment humidity, ability to trap warm air, introduction of human dander (perhaps with a yet to be determined minimal frequency), increased surface area due to roughness/ fibers/complexity, depth of

viability within the material (can a reservoir survive beneath where it is removed by vacuuming and ordinary movement), etc.

Several linear regressions were performed to determine whether a relationship exists between the laboratory reported antigen concentrations in terms of ng of antigen per gram of sieved dust and more conventional surface sampling concentration terms. Der p 1 data was not used for these analyses because there were so many results below the detection limit, and data from other allergens was more complete.

The conventional unit of the allergy field, ng/g, is compared to the traditional industrial hygiene standard sample unit of ng/unit area, in this case ng/ft². A hybrid unit of ng/ft²(min) is also evaluated due to the obvious effect, within reasonable bounds, that increased collection time would have on the amount of both dust and allergen extracted from a surface. The exact nature of variation in collection time and the bounds of linearity have not been determined in this paper, but collection times were between 4 and 10 minutes and were believed not to have reached the "saturation point" by observation. Collection technique was attempted in such a way as to uniformly cover each surface with the vacuum attachment, which required moderate variation in speed of movement of the attachment.

For this analysis the Der f 1 and Fel d 1 results below the reported detection limit of 50 ng/g were not used. The logarithms of the antigen concentrations were used in the linear regressions for reasons already stated in previous analyses. There was a weak but significant correlation ($r = 0.666$, $p < 0.05$) between Der f 1 in ng/g and Der f 1 in ng/sf*min. The factor of food consumption was significant in this analysis. Interactions between food and other factors were previously noted in the analyses of variance discussed above. Der f 1 in ng/sf correlated with units of ng/g with $r = 0.679$. In this analysis, food consumption was also significant.

See Appendix 11 for details of statistical analyses.

Correlation of Fel d 1 antigen in ng/g with the units of ng/sf and ng/sf*min were very strong with $r = 0.94$ for each ($p < 0.05$). The presence or absence of a cat is the most significant factor. Whether the surface type was a sofa/chair was also significant, as noted previously. See Appendix 12 for details of statistical analyses.

2. Air Sample Results. Air samples were collected at various sites, using a vacuum pump, critical orifice, and 37 mm glass fiber filter in a closed-face cassette. Three blank samples were treated similarly to the air sample cassettes. They showed no detectable antigen. Table 12 gives results of air samples for Der f 1. All samples were none detected for Der p 1.

TABLE 12
AIR SAMPLE RESULTS FOR DER F 1

<u>Sample Number</u>	<u>Volume (m³)</u>	<u>Concentration (ng/m³)</u>	<u>Activity</u>	<u>Location</u>
A612	21.270	0.046	Moderate	A/BR/next to futon 24 hrs
A613	0.472	<1.059	High	B/LR/next to cat chair
A614	21.683	<0.023	Low	B/LR/next to cat chair
A615	22.420	<0.022	Mod	A/MBR/next to futon/sleep,vac
A616	38.512	<0.013	Low	A/LR/cassette on sofa
A617	21.314	<0.023	Moderate	A/BR2/head of child bed
A618	10.664	<0.047	Low	B/FR/next to cat chair
A619	21.255	<0.024	None	B/FR/right chair
A621	0.428	<1.1682	High	B/FR/vacuum sampling
A622	11.505	<0.043	Low	B/FR/Left easy chair
A623	9.735	<0.051	Low	B/FR/left chair
A624	20.488	<0.024	Moderate	B/DR/cat sleeping spot

A625	20.827	<0.024	Mod-Hi	E/LR/between chairs
A626	9.514	<0.053	Moderate	D/BR/head of bed
A628	21.314	<0.02	Moderate	C/FR/by sofa
A629A	21.240	<0.024	Moderate	G/LR/near sofa
A629B	20.945	<0.024	Moderate	F/LR/near cat chair

Note: LR is living room, FR is family room, BR is bedroom, DR is dining room.

Table 13 contains air sample results for cat allergen Fel d 1.

TABLE 13
AIR SAMPLE RESULTS FOR FEL D 1

<u>Sample Number</u>	<u>Volume (m³)</u>	<u>Concentration (ng/m³)</u>	<u>Activity</u>	<u>Location</u>
A612	21.270	0.029	Moderate	A/BR/next to futon 24 hrs
A613	0.472	61.441	High	B/LR/next to cat chair
A614	21.683	0.101	Low	B/LR/next to cat chair
A615	22.420	<0.022	Mod	A/MBR/next to futon/sleep, vac
A616	38.512	<0.013	Low	A/LR/cassette on sofa
A617	21.314	<0.023	Moderate	A/BR2/head of child bed
A618	10.664	<0.047	Low	B/FR/next to cat chair
A619	21.255	0.080	None	B/FR/right chair
A621	0.428	<1.1682	High	B/FR/vacuum sampling
A622	11.505	<0.043	Low	B/FR/Left easy chair
A623	9.735	<0.053	Low	B/FR/left chair
A624	20.488	0.054	Moderate	B/DR/cat sleeping spot
A625	20.827	<0.055	Mod-Hi	E/LR/between chairs
A626	9.514	<0.055	Moderate	D/BR/head of bed
A628	21.314	<0.018	Moderate	C/FR/by sofa
A629A	21.240	0.019	Moderate	G/LR/near sofa
A629B	20.945	0.019	Moderate	F/LR/near cat chair

An attempt was made to analyze the relationship between vacuum sample results and air sample results. Unfortunately, there was only one detectable air sample result for Der f 1, and it was at or below the detection limit of the remainder of the air samples. The only conclusion that can be drawn from this is that sample volumes in excess of 22000 liters are required to detect mite antigen in air samples.

There were seven detectable air samples for Fel d 1 antigen, out of a total of 17 air samples collected. A linear regression was conducted to determine if there was any relationship between surface sample antigen and airborne levels in the seven air samples that exceeded the limit of detection. There was no significant correlation between these two measures. Factors of presence or absence of a cat, and the activity level measure (scalar of 1 to 4 assigned as an indicator of the amount of mechanical disturbance of the surface during the sample period) were added in an analysis of covariance. These factors still did not make for a correlation between surface and airborne antigen level, even when a high activity level and presence of a cat were taken into account. See Appendix 13 for statistical analyses details.

From these limited data there appears to be no relationship between surface antigen levels and airborne levels for Fel d 1, even with the two factors most likely to influence this relationship accounted for.

V. Conclusions.

To summarize, the following conclusions are drawn:

1. Samples of household dust from one source may vary widely ($\pm 28\%$) when submitted as blind samples. This could be due to variation within the dust source or variation in the analytical method.
2. Dust greater than 212 μm did not contain antigen in a typical household dust sample, yet this dust would be considered in the denominator

as part of total dust in some antigen concentration expressions.

3. When loading air samples with a known concentration of antigen expressed as ng/g, the same ratio of ng of antigen to g of dust does not hold on the air sample filter. In the sample tested in this investigation, the amount of Der f 1 was much lower than expected, but the level of Fel d 1 was higher than expected. This indicates potential analytical biases may be present using current air sample filter allergen methods.

4. The impact of vacuum sample collection time requires further study.

5. Factors influencing antigen concentration in various reservoirs require further study to ascertain which are most important and the degree to which they impact surface antigen quantification.

6. A vacuum surface sample should be expressed in terms of ng per unit area, perhaps taking into account the sample collection time or volume.

7. Surface levels of Der f 1 expressed in ng/g do not correlate well with ng per unit area.

8. Surface sample levels of Fel d 1 expressed in ng/g correlate well with units of ng/ft² and with ng/ft²(min).

9. With the current air sample filter analytical method, air volumes in excess of 22 cubic meters are required to achieve detectable Der f 1 levels.

10. Based on limited data, there was no relationship between airborne and surface levels of Fel d 1, even with presence or absence of a cat and the activity level taken into account.

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APPENDIX 1

DESCRIPTION OF SAMPLE SITES

APPENDIX 1

DESCRIPTION OF SAMPLE SITES

The following sites were sampled.

1. HOUSE A. Gambrills, MD. This home is occupied by a family two adults and 0852 children. The home is 18 years old and has had present occupants almost one year. Sites were selected within the home as follows:

a. Master Bedroom: futon and surrounding carpet. Futon rests directly on the floor. Surface sample numbers V001 and V013 were taken from futon pad and futon; number V002 was collected from the surrounding carpet.

b. Upstairs childrens' bedroom: Child's futon was selected because she sweats profusely at night, goes to bed with wet hair, and has wet the bed frequently for years. Sample #V003 was collected from both sides of the futon and the underlying mattress (her futon is on top of a twin bed); #V004 was from the surrounding carpet.

c. Lower floor livingroom: The sofa and carpet were sampled. #V005 was from the sofa seat and back cushions; #V006 was from the carpet.

d. Lower floor childrens' bedroom: The futon on the lower bunk bed was sampled because that child sweats profusely at night, wets about once a week, and goes to bed with wet hair. Sample #V007 was collected from both sides of the futon; #V008 was from the carpet in that room, which was brought from Guam (not wall-to-wall). This room is also shared by the laundry.

2. HOUSE B. Gambrills. MD. This home is occupied by two adults, one long-hair cat, and a poodle in the home. It is also about 18 years old. Sample #V009 was collected from the two velour easy chairs, which the cat and dog spend a lot of time on. Sample #V010 was collected from the carpet

in the same room. V033 was collected from the carpet in the dining room in front of the sliding glass door where the cat likes to sleep.

3. HOUSE C. Severn, MD. This home is occupied by a couple with 5 children. The mother has recently been diagnosed as having several allergies. The first floor family room sofa top surfaces were sampled #V011; and the carpet in front of the TV was sampled #V012.

4. HOUSE D. Gambrills, MD. This home is half of a duplex, and is occupied by a couple with three children. One child is asthmatic and has allergies. The asthmatic child's mattress was sampled #V014, and the carpet beside her bed was sampled #V015.

5. HOUSE E. Ft Meade, MD. This home is occupied by two adults, two teenagers and two dogs; and the home is used as a home day care center for up to 6 children (generally toddlers ages 1 to 4). Three areas were sampled in the livingroom, which is occupied most of each day: V016 was from the carpet, which is vacuumed twice a day; V017 was from a velour reclining chair; V018 was from an old chair used by the children for naps. One adult smokes, the other quit a couple of months ago.

6. HOUSE F. Laurel, MD. This home is occupied by two adults and two indoor-only cats who were shedding quite heavily at the time of sampling. Two samples were collected: V019 was collected from a velour chair that the cats sleep on frequently; V020 was collected from the carpet in front of this chair.

7. HOUSE G. Bolling AFB, DC. This home is occupied by two adults and three children. Four samples were collected. Sample V021 was from one of the livingroom sofas, and V022 was from the floor in front of it. Sample V023 was collected from a braided carpet in the boys' bedroom, and V024 was collected from three of their bed pillows.

8. HOUSE H. Columbia, MD. This is a three-story townhouse occupied by a

couple with two young children. Sample V025 was collected from the couch in the family room; V026, from the carpet in front of the TV; V027, from the feather pillow and down comforter in the master bedroom.

9. HOUSE I. Laurel, MD. This home is in an apartment building, and is occupied by a couple with older children. The wife sleeps on a feather pillow, and has symptoms indicating house dust allergy. Four of her siblings and a parent have asthma. Sample V038 was collected from the feather pillow; V039, from the mattress surface; and V040 from the carpet beside the bed in the master bedroom.

APPENDIX 2

VACUUM SAMPLE FORM

SAMPLING DATA COLLECTION FORM

VACUUM SURFACE SAMPLES

SAMPLE NUMBER:

DATE OF SAMPLE COLLECTION:

START TIME:

FINISH TIME:

TOTAL SAMPLE TIME:

AREA SAMPLED (SQUARE INCHES OR SQUARE FEET):

SAMPLE LOCATION

ADDRESS:

ROOM AND FLOOR:

TYPE OF SURFACE:

SPECIAL FEATURES:

CONDITIONS AT TIME OF SAMPLE COLLECTION

WINDOWS OPEN?

AIR CONDITIONING ON?

LAST TIME PET WAS IN ROOM AND TYPE OF PET:

ANY SPECIAL TREATMENTS DONE TO REDUCE DUST OR OTHER
ALLERGENS:

DOES ANYONE SMOKE IN THIS ROOM?

ARE FOODS STORED OR CONSUMED IN THIS ROOM (GIVE FREQUENCY):

APPENDIX 3

AIR SAMPLING FORM

AIR SAMPLE DATA COLLECTION FORM - AIRBORNE ALLERGEN STUDY
TOTAL DUST SAMPLE

SAMPLE NUMBER:

SAMPLE COLLECTION DATES:

START TIME/DATE:

FINISH TIME/DATE:

TOTAL SAMPLE TIME:

PUMP USED:

CRITICAL ORIFICE SN AND NOMINAL FLOW:

CRITICAL ORIFICE ACTUAL FLOW AND CALIBRATION DATA:

SAMPLE VOLUME:

SAMPLE LOCATION

ADDRESS:

ROOM AND FLOOR/S (SPECIFY TIME AT EACH IF MORE THAN ONE):

HEIGHT:

CONDITIONS AT TIME OF SAMPLING:

WINDOWS OPEN (GENERAL WEATHER CONDITIONS IF YES)?

AIR CONDITIONING ON (CENTRAL OR WINDOW)?

FAN ON?

LAST TIME PET WAS IN ROOM/S AND TYPE OF PET:

ANY SPECIAL TREATMENTS DONE TO REDUCE DUST OR OTHER
ALLERGENS (AIR CLEANERS, ETC):

DOES ANYONE SMOKE IN THIS ROOM?

ARE FOODS STORED OR CONSUMED IN THIS ROOM:

NUMBER OF HOURS ROOM WAS OCCUPIED DURING SAMPLE PERIOD AND TYPE OF ACTIVITY DONE (E.G. 8 HRS OF SLEEPING BY 1 CHILD, WATCHED TV 2 HRS, VACUUMED, DUSTED, WRESTLED WITH DOG, ETC):

IS THERE A LARGE, MEDIUM, OR SMALL HORIZONTAL SURFACE AREA IN THIS ROOM? DESCRIBE.

IS THERE TEXTURED WALLPAPER?

DESCRIBE FLOORING (WALL-TO-WALL CARPET, DEEP PILE OR SHORT, BARE WOOD OR TILE FLOOR, THROW-RUG, ETC)

AVERAGE NUMBER OF OCCUPANTS IN HOME (INCLUDE FREQUENT OCCUPANTS SUCH AS CHILDREN WHO ARE PROVIDED HOME DAYCARE), BY AGE:

0-1:

1-3:

4-12:

12-17:

18-35:

36-55:

55+:

APPENDIX 4

LINEAR REFRESSION/ANCOVA
VACUUM SAMPLE TIME VS AREA

```

[0] GLIM 3.77 update 1 (copyright)1985 Royal Statistical Society, London
[0]
[i] ? $input 12$
[i] File name? a:vac2.doc
[i] $subfile a:vac2.doc
[i] $units 41$
[i] !This is a data set of all vacuum samples which were collected then
[i] !determined to have sufficient mass to be analyzed by the DAC Lab.
[i] !dtot = the total mass of dust removed from the filter. mngg= mass of
[i] !Der f I mite allergen in nanograms per gram of total dust. cngg= mass
[i] !of Fel d I cat allergen in nanograms per gram of total dust. time=
[i] !sample collection time in minutes. area= the area of surface vacuumed
[i] !in square feet. type= tpe of surface; 1 is carpet 2 is sofa or chair
[i] !3 is mattress or pillow. trap = a number to scale from 1 to 3 to indic
[i] !the thickness/depth combination of the source/surface. no = the sample
[i] $data no dtot mngg cngg time area type trap cat food$
[i] $read
[i] 1 0.328 767 97 8 115.1 3 3 1 1
[i] 2 0.245 1156 57 8 60 1 3 1 1
[i] 3 0.227 118 997 7 19 3 3 1 1
[i] 4 0.227 116 132 7 52.7 1 2 1 1
[i] 5 0.621 60 563 5 37.5 2 2 1 2
[i] 6 0.063 247 25 5 47 1 2 1 2
[i] 7 0.159 25 157 8 37.5 3 3 1 1
[i] 8 0.179 25 557 6 40 1 2 1 1
[i] 9 0.135 54 2323180 6 17.1 2 3 2 3
[i] 10 0.034 70 264397 10 33.8 1 1 2 3
[i] 11 0.696 318 3323 8.5 23.125 2 3 1 4
[i] 12 0.099 222 2281 7.5 14.6 1 3 1 4
[i] 13 0.247 1167 202 7 76.7 3 3 1 1
[i] 14 0.338 168 97 4.5 9.5 3 1 1 1
[i] 15 0.621 175 228 5 12.75 1 3 1 1
[i] 16 0.886 25 25 5 12 1 3 1 4
[i] 17 0.083 25 207 4 8.7 1 3 1 4
[i] 18 0.322 373 25 5 6.4 2 3 1 4
[i] 19 0.087 836 8777972 4 4.3 2 3 2 3
[i] 20 0.024 5718 1830677 5 9.9 1 2 2 3
[i] 21 0.068 301 613 5 13 2 3 1 4
[i] 22 1.302 513 229 7 19.4 1 3 1 4
[i] 23 0.393 208 124 7 12.8 1 3 1 3
[i] 24 0.020 205 25 4.5 20.25 3 1 1 3
[i] 25 0.219 20886 57 8 22.3 1 3 1 3
[i] 26 0.034 3183 25 4 11.9 1 2 1 3
[i] 27 0.038 201 25 4 26.2 3 3 1 1
[i] 28 0.949 62 1350 7.5 23.8 2 2 1 2
[i] 29 0.145 115 25 9 19.0 3 3 1 1
[i] 30 0.148 371 152 7 38.4 3 3 1 1
[i] 32 0.152 59 3134314 4 8.2 2 3 2 3
[i] 33 1.029 25 147843 4 6.0 1 2 2 3
[i] 34 0.372 25 114042 4.5 6.1 1 2 2 3
[i] 35 0.036 548 25 7 6.4 2 3 1 4
[i] 36 0.992 190 305 5 9.0 1 3 1 1
[i] 37 0.040 125 514 6 18.1 3 1 1 1
[i] 39 0.180 976 25 5 7.8 3 1 1 4
[i] 41 0.3138 1233 1051 9 11.3 2 3 1 4
[i] 42 0.2433 1657 461 8 11.7 1 3 1 4
[i] 44 0.4155 292 298 6 8.9 2 3 1 4
[i] 45 1.3827 454 25 6 10.3 1 3 1 4

```



```

[o] [ 15., 30.) 7 SSSSSSS
[o] [ 30., 45.) 2 SS
[o] [ 45., 60.) 0
[o] [ 60., 75.] 1 S
[i] ? !a bit skewed
[i] ?
[i] ? $fit -%gm$dis e$
[o] deviance = 674.97 (change = +580.8)
[o] d.f. = 40 (change = +1 )
[o]
[o] estimate s.e. parameter
[o] 1 0.1554 0.02023 AREA
[o] scale parameter taken as 16.87
[o]
[i] ? !That subtracted the grand mean and forced the line through the origin
[i] ? !no time for no area.
[i] ? $fit +trap$dis e$fit +type$dis e$fit +cat$dis e$
[o] deviance = 83.834 (change = -591.1)
[o] d.f. = 37 (change = -3 )
[o]
[o] estimate s.e. parameter
[o] 1 0.03020 0.01089 AREA
[o] 2 5.460 0.7008 TRAP(1)
[o] 3 4.545 0.5767 TRAP(2)
[o] 4 5.783 0.3839 TRAP(3)
[o] scale parameter taken as 2.266
[o]
[o] deviance = 80.404 (change = -3.430)
[o] d.f. = 35 (change = -2 )
[o]
[o] estimate s.e. parameter
[o] 1 0.03695 0.01243 AREA
[o] 2 6.029 0.8596 TRAP(1)
[o] 3 4.378 0.6234 TRAP(2)
[o] 4 5.865 0.4819 TRAP(3)
[o] 5 -0.04090 0.5927 TYPE(2)
[o] 6 -0.8624 0.7218 TYPE(3)
[o] scale parameter taken as 2.297
[o]
[o] deviance = 79.332 (change = -1.072)
[o] d.f. = 34 (change = -1 )
[o]
[o] estimate s.e. parameter
[o] 1 0.03584 0.01263 AREA
[o] 2 6.205 0.9042 TRAP(1)
[o] 3 4.553 0.6793 TRAP(2)
[o] 4 5.948 0.5009 TRAP(3)
[o] 5 0.003016 0.6008 TYPE(2)
[o] 6 -0.9402 0.7364 TYPE(3)
[o] 7 -0.4682 0.6908 CAT(2)
[o] scale parameter taken as 2.333
[o]
[i] ? !trapping and presence of a cat are significant in the length of time
[i] ? !it took to vacuum a given area
[i] ? $tab the time mean for trap;cat;type$
[w] -- the table contains empty cell(s)
[o] 1 2
[o] 1 2 3 1 2 3

```

[o]	1	0.000	0.000	5.000	10.000	0.000	0.000
[o]	2	5.500	6.250	0.000	4.500	0.000	0.000
[o]	3	6.409	6.750	7.143	0.000	4.667	0.000

[i] ? \$stop\$

APPENDIX 5

HISTOGRAMS OF DER F 1 and FEL D 1 VACUUM SAMPLE RESULTS

```

[O] GLIM 3.77 update 1 (copyright)1985 Royal Statistical Society, London
[O]
[i] ? $input 12$
[i] File name? a:vac2.doc
[i] $subfile a:vac2.doc
[i] $units 41$
[i] !This is a data set of all vacuum samples which were collected then
[i] !determined to have sufficient mass to be analyzed by the DACI Lab.
[i] !dtot = the total mass of dust removed from the filter. mnngg= mass of
[i] !Der f I mite allergen in nanograms per gram of total dust. cnngg= mass
[i] !of Fel d I cat allergen in nanograms per gram of total dust. time=
[i] !sample collection time in minutes. area= the area of surface vacuumed
[i] !in square feet. type= tpe of surface; 1 is carpet 2 is sofa or chair
[i] !3 is mattress or pillow. trap = a number to scale from 1 to 3 to indic
[i] !the thickness/depth combination of the source/surface. no = the sample
[i] $data no dtot mnngg cnngg time area type trap cat food$
[i] $read
[i] 1 0.328 767 97 8 115.1 3 3 1 1
[i] 2 0.245 1156 57 8 60 1 3 1 1
[i] 3 0.227 118 997 7 19 3 3 1 1
[i] 4 0.227 116 132 7 52.7 1 2 1 1
[i] 5 0.621 60 563 5 37.5 2 2 1 2
[i] 6 0.063 247 25 5 47 1 2 1 2
[i] 7 0.159 25 157 8 37.5 3 3 1 1
[i] 8 0.179 25 557 6 40 1 2 1 1
[i] 9 0.135 54 2323180 6 17.1 2 3 2 3
[i] 10 0.034 70 264397 10 33.8 1 1 2 3
[i] 11 0.696 318 3323 8.5 23.125 2 3 1 4
[i] 12 0.099 222 2281 7.5 14.6 1 3 1 4
[i] 13 0.247 1167 202 7 76.7 3 3 1 1
[i] 14 0.338 168 97 4.5 9.5 3 1 1 1
[i] 15 0.621 175 228 5 12.75 1 3 1 1
[i] 16 0.886 25 25 5 12 1 3 1 4
[i] 17 0.083 25 207 4 8.7 1 3 1 4
[i] 18 0.322 373 25 5 6.4 2 3 1 4
[i] 19 0.087 836 8777972 4 4.3 2 3 2 3
[i] 20 0.024 5718 1830677 5 9.9 1 2 2 3
[i] 21 0.068 301 613 5 13 2 3 1 4
[i] 22 1.302 513 229 7 19.4 1 3 1 4
[i] 23 0.393 208 124 7 12.8 1 3 1 3
[i] 24 0.020 205 25 4.5 20.25 3 1 1 3
[i] 25 0.219 20886 57 8 22.3 1 3 1 3
[i] 26 0.034 3183 25 4 11.9 1 2 1 3
[i] 27 0.038 201 25 4 26.2 3 3 1 1
[i] 28 0.949 62 1350 7.5 23.8 2 2 1 2
[i] 29 0.145 115 25 9 19.0 3 3 1 1
[i] 30 0.148 371 152 7 38.4 3 3 1 1
[i] 32 0.152 59 3134314 4 8.2 2 3 2 3
[i] 33 1.029 25 147843 4 6.0 1 2 2 3
[i] 34 0.372 25 114042 4.5 6.1 1 2 2 3
[i] 35 0.036 548 25 7 6.4 2 3 1 4
[i] 36 0.992 190 305 5 9.0 1 3 1 1
[i] 37 0.040 125 514 6 18.1 3 1 1 1
[i] 39 0.180 976 25 5 7.8 3 1 1 4
[i] 41 0.3138 1233 1051 9 11.3 2 3 1 4
[i] 42 0.2433 1657 461 8 11.7 1 3 1 4
[i] 44 0.4155 292 298 6 8.9 2 3 1 4
[i] 45 1.3827 454 25 6 10.3 1 3 1 4

```

```

[i]
[i] $finish$
[i] ? $hist cngg$tab the cngg mean$tab the cngg se$
[o] [ 0.,1500000.) 37 CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
[o] [1500000.,3000000.) 2 CC
[o] [3000000.,4500000.) 1 C
[o] [4500000.,6000000.) 0
[o] [6000000.,7500000.) 0
[o] [7500000.,9000000.] 1 C
[o] 405042.
[o] 25.00
[i] ? !This is the histogram of Fel d 1 antigen in ng/g with mean and se
[i] ? $calc lc=%log cngg$hist lc$
[o] [ 2.5, 5.0) 16 LLLLLLLLLLLLLLLLLL
[o] [ 5.0, 7.5) 16 LLLLLLLLLLLLLLLLLL
[o] [ 7.5,10.0) 2 LL
[o] [10.0,12.5) 3 LLL
[o] [12.5,15.0) 3 LLL
[o] [15.0,17.5) 1 L

```

```

[i] ? $tab the lc mean$tab the lc se$
[o] 6.501
[o] 3.219
[i] ? !This is the histogram of the ln of Fel d 1 in ng/g with mean and se.
[i] ? !Bimodal due to whether or not there is a cat present.
[i] ? $calc ctot=cngg*dtot$hist ctot$tab the ctot mean for cat$
[o] [ 0.,150000.) 37 CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
[o] [150000.,300000.) 1 C
[o] [300000.,450000.) 1 C
[o] [450000.,600000.) 1 C
[o] [600000.,750000.) 0
[o] [750000.,900000.] 1 C
[o] 1.000 2.000
[o] [] 183. 257316.
[i] ? $tab the ctot se for cat$
[o] 1.000 2.000
[o] [] 1. 8989.

```

```

[i] ? $calc lctot=%log ctot$hist lctot$tab the lctot mean for cat$
[o] [ -1.0, 1.5) 6 LLLLLL
[o] [ 1.5, 4.0) 16 LLLLLLLLLLLLLLLLLL
[o] [ 4.0, 6.5) 10 LLLLLLLLLL
[o] [ 6.5, 9.0) 2 LL

```

```

[o] [ 9.0, 11.5) 3 LLL
[o] [ 11.5, 14.0] 4 LLLL
[o]      1.000 2.000
[o]      [] 3.47 11.67
[i] ? $stab the lctot se for cat$
[o]      1.000 2.000
[o]      [] -0.693 9.104
[i] ? !This is the histogram of ln of total Fel d 1 on the sample filter
[i] ? !with means 1=no cat, 2=cat present.
[i] ? $scal ccsf=ctot/area$

```

```

[i] ? $hist ccsf$stab the ccsf mean for cat$stab the ccsf se for cat$
[o] [ 0., 30000.) 39 CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
[o] [ 30000., 60000.) 1 C
[o] [ 60000., 90000.) 0
[o] [ 90000., 120000.) 0
[o] [ 120000., 150000.) 0
[o] [ 150000., 180000.) 1 C
[o]      1.000 2.000
[o]      [] 10. 41579.
[o]      1.000 2.000
[o]      [] 0.0 266.0
[i] ? !This is a histogram of Fel d 1 in ng/sf with means and se w/ and w/ou
[i] ?
[i] ? $scal lcsf=%log ccsf$hist lcsf$stab the lcsf mean for cat$
[o] [ -4.5, -1.5) 6 LLLLLL
[o] [ -1.5, 1.5) 17 LLLLLLLLLLLLLLLLLL
[o] [ 1.5, 4.5) 10 LLLLLLLLLL
[o] [ 4.5, 7.5) 2 LL
[o] [ 7.5, 10.5) 4 LLLL
[o] [ 10.5, 13.5) 2 LL
[o]      1.000 2.000
[o]      [] 0.529 9.406

```

```

[i] ? $stab the lcsf se for cat$
[o]      1.000 2.000
[o]      [] -3.701 5.583
[i] ? !This is the histogram of the ln of Fel d 1 in ng/sf with means and se
[i] ? $scal ta=time*area$scal cta=ctot/ta$hist cta$
[o] [ 0., 8000.) 39 CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
[o] [ 8000., 16000.) 1 C
[o] [ 16000., 24000.) 0
[o] [ 24000., 32000.) 0
[o] [ 32000., 40000.) 0
[o] [ 40000., 48000.) 1 C

```

```

[i] ? $stab the cta mean for cat$stab the cta se for cat$
[o]      1.000  2.000
[o]      []    1.  10111.
[o]      1.000  2.000
[o]      []    0.01 26.60
[i] ? $calc lcta=%log cta$h1st lcta$stab the lcta mean for cat$
[o] [ -6.0, -3.0) 8  LLLLLLLL
[o] [ -3.0,  0.0) 15 LLLLLLLLLLLLLLLL
[o] [  0.0,  3.0) 11 LLLLLLLLLLLL
[o] [  3.0,  6.0) 1  L
[o] [  6.0,  9.0) 4  LLLL
[o] [  9.0, 12.0) 2  LL
[o]      1.000  2.000
[o]      [] -1.288 7.782

```

```

[i] ? $stab the lcta se for cat$
[o]      1.000  2.000
[o]      [] -5.205 3.281
[i] ? !This is a histogram of the ln of Fel d 1 in ng/sf*min with mean and s
[i] ?

```

```
[i]
[i] $finish$
[i] ? $tab the mngg mean$tab the mngg se$
[o]      1056.
[o]      25.00
[i] ? $stop$
```



```

[i] ? !This is a histogram of Der f 1 in ng/sf
[i] ? $Tab the msf mean$tab the msf se$
[o]      13.43
[o]      0.07041
[i] ? $calc lmsf=%log msf$hist lmsf$tab the lmsf mean$tab the lmsf se$
[o] [-3.0,-1.5) 4  LLLL
[o] [-1.5, 0.0) 8  LLLLLLLL
[o] [ 0.0, 1.5) 12 LLLLLLLLLLLL
[o] [ 1.5, 3.0) 10 LLLLLLLLLLL
[o] [ 3.0, 4.5) 6  LLLLLL
[o] [ 4.5, 6.0] 1  L
[o]      1.021
[o]      -2.653
[i] ? !This is a histogram of the ln of Der f 1 in ng/sf, with mean and se
[i] ? $calc ta=time*area$calc mta=mtot/ta$hist mta$tab the mta mean$
[o] [ 0.0, 5.0) 39 MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
[o] [ 5.0,10.0) 0
[o] [10.0,15.0) 1  M
[o] [15.0,20.0) 0
[o] [20.0,25.0) 0
[o] [25.0,30.0] 1  M
[o]      2.044
[i] ? $tab the mta se$
[o]      0.007041

```

```

[i] ? $calc lmta=%log mta$hist lmta$tab the lmta mean$tab the lmta se$
[o] [-5.00,-3.50) 3  LLL
[o] [-3.50,-2.00) 8  LLLLLLLL
[o] [-2.00,-0.50) 13 LLLLLLLLLLLLLL
[o] [-0.50, 1.00) 7  LLLLLLL
[o] [ 1.00, 2.50) 9  LLLLLLLLLL
[o] [ 2.50, 4.00] 1  L
[o]      -0.7634
[o]      -4.956
[i] ? !This is a histogram of the ln of Der f 1 in ng/sf*min with mean and
[i] ?
[i] ?
[i] ?
[i] ? $yvar msf$fac food 4$fac cat 2$fac type 3$fac trap 3$error n$link is
[i] ? $fit %gm$dis e$
[o] deviance = 44313.
[o] d.f. = 40
[o]
[o]      estimate      s.e.      parameter
[o]      1      13.43      5.198      1
[o]      scale parameter taken as 1108.
[o]
[i] ? $fit +type$dis e$
[o] deviance = 41812. (change = -2501.)
[o] d.f. = 38 (change = -2 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      21.52      7.610      1

```

[o] 2 -12.18 12.57 TYPE(2)
[o] 3 -17.97 12.57 TYPE(3)
[o] scale parameter taken as 1100.
[o]
[i] ? \$tab the msf mean for type\$
[o] 1 2 3
[o] [] 21.520 9.342 3.549

APPENDIX 6

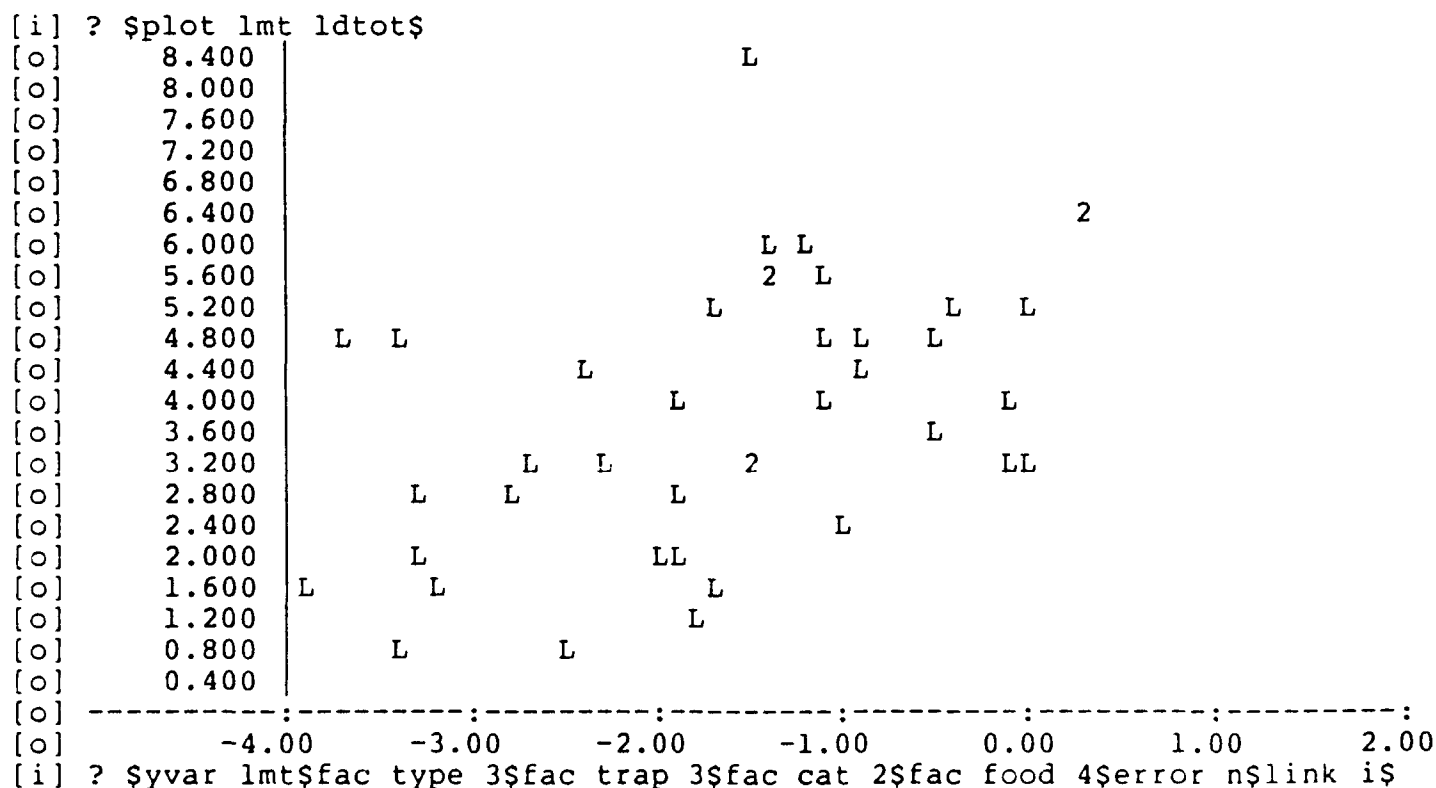
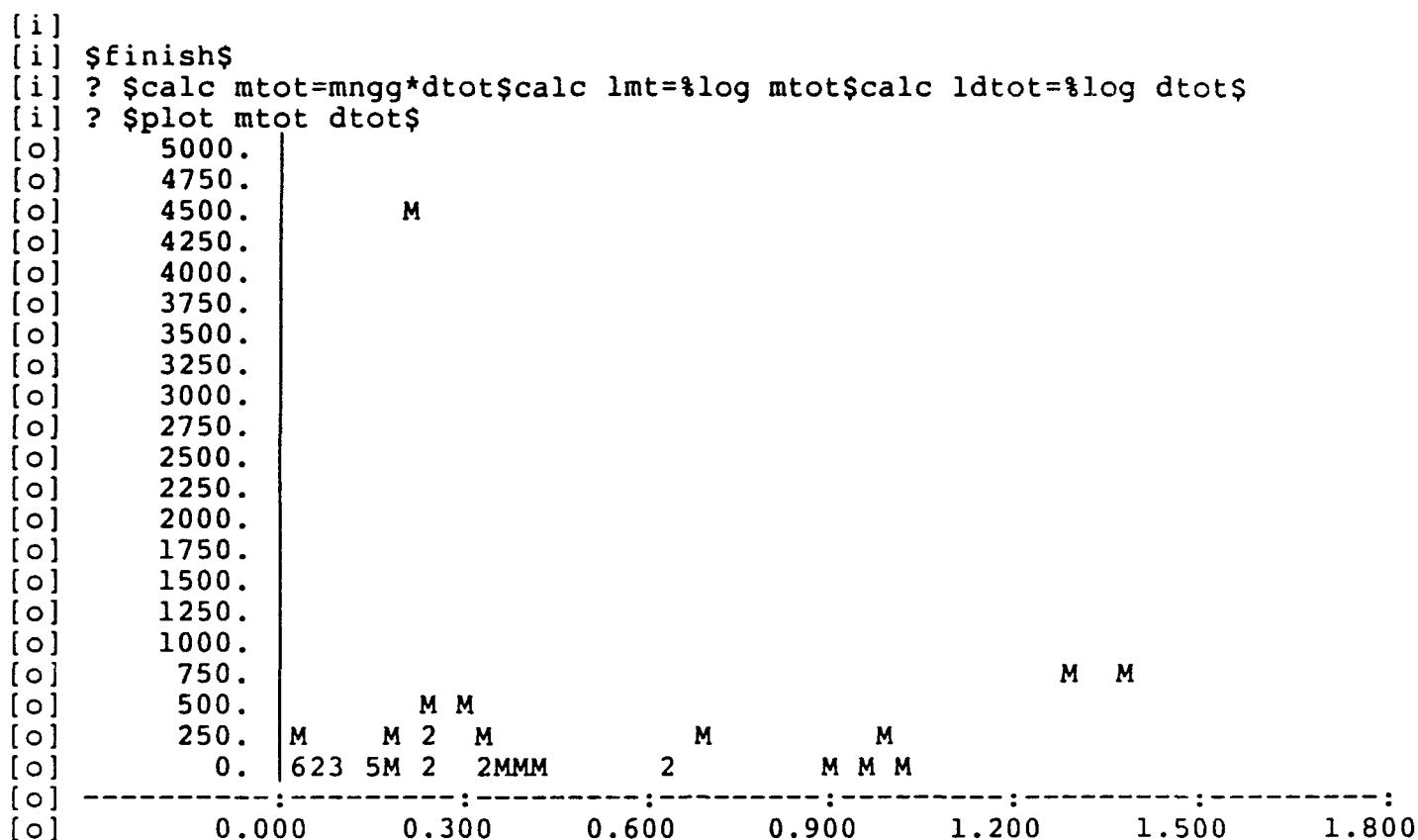
LINEAR REGRESSION/ANCOVA

TOTAL DER F 1 VS TOTAL SIEVED DUST

```

[o] GLIM 3.77 update 1 (copyright)1985 Royal Statistical Society, London
[o]
[i] ? $input 12$
[i] File name? a:vac2.doc
[i] $subfile a:vac2.doc
[i] $units 41$
[i] !This is a data set of all vacuum samples which were collected then
[i] !determined to have sufficient mass to be analyzed by the DACI Lab.
[i] !dtot = the total mass of dust removed from the filter. mngg= mass of
[i] !Der f I mite allergen in nanograms per gram of total dust. cngg= mass
[i] !of Fel d I cat allergen in nanograms per gram of total dust. time=
[i] !sample collection time in minutes. area= the area of surface vacuumed
[i] !in square feet. type= tpe of surface; 1 is carpet 2 is sofa or chair
[i] !3 is mattress or pillow. trap = a number to scale from 1 to 3 to indic
[i] !the thickness/depth combination of the source/surface. no = the sample
[i] $data no dtot mngg cngg time area type trap cat food$
[i] $read
[i] 1 0.328 767 97 8 115.1 3 3 1 1
[i] 2 0.245 1156 57 8 60 1 3 1 1
[i] 3 0.227 118 997 7 19 3 3 1 1
[i] 4 0.227 116 132 7 52.7 1 2 1 1
[i] 5 0.621 60 563 5 37.5 2 2 1 2
[i] 6 0.063 247 25 5 47 1 2 1 2
[i] 7 0.159 25 157 8 37.5 3 3 1 1
[i] 8 0.179 25 557 6 40 1 2 1 1
[i] 9 0.135 54 2323180 6 17.1 2 3 2 3
[i] 10 0.034 70 264397 10 33.8 1 1 2 3
[i] 11 0.696 318 3323 8.5 23.125 2 3 1 4
[i] 12 0.099 222 2281 7.5 14.6 1 3 1 4
[i] 13 0.247 1167 202 7 76.7 3 3 1 1
[i] 14 0.338 168 97 4.5 9.5 3 1 1 1
[i] 15 0.621 175 228 5 12.75 1 3 1 1
[i] 16 0.886 25 25 5 12 1 3 1 4
[i] 17 0.083 25 207 4 8.7 1 3 1 4
[i] 18 0.322 373 25 5 6.4 2 3 1 4
[i] 19 0.087 836 8777972 4 4.3 2 3 2 3
[i] 20 0.024 5718 1830677 5 9.9 1 2 2 3
[i] 21 0.068 301 613 5 13 2 3 1 4
[i] 22 1.302 513 229 7 19.4 1 3 1 4
[i] 23 0.393 208 124 7 12.8 1 3 1 3
[i] 24 0.020 205 25 4.5 20.25 3 1 1 3
[i] 25 0.219 20886 57 8 22.3 1 3 1 3
[i] 26 0.034 3183 25 4 11.9 1 2 1 3
[i] 27 0.038 201 25 4 26.2 3 3 1 1
[i] 28 0.949 62 1350 7.5 23.8 2 2 1 2
[i] 29 0.145 115 25 9 19.0 3 3 1 1
[i] 30 0.148 371 152 7 38.4 3 3 1 1
[i] 32 0.152 59 3134314 4 8.2 2 3 2 3
[i] 33 1.029 25 147843 4 6.0 1 2 2 3
[i] 34 0.372 25 114042 4.5 6.1 1 2 2 3
[i] 35 0.036 548 25 7 6.4 2 3 1 4
[i] 36 0.992 190 305 5 9.0 1 3 1 1
[i] 37 0.040 125 514 6 18.1 3 1 1 1
[i] 39 0.180 976 25 5 7.8 3 1 1 4
[i] 41 0.3138 1233 1051 9 11.3 2 3 1 4
[i] 42 0.2433 1657 461 8 11.7 1 3 1 4
[i] 44 0.4155 292 298 6 8.9 2 3 1 4
[i] 45 1.3827 454 25 6 10.3 1 3 1 4

```




```

[O]
[O] deviance = 87.640 (change = -1.352)
[O]   d.f. = 35      (change = -2      )
[O]
[O]           estimate      s.e.      parameter
[O]   1           4.686        1.049        1
[O]   2           0.6441       0.2337       LDTO
[O]   3          -0.2000       1.039       TRAP(2)
[O]   4           0.7102       0.8840       TRAP(3)
[O]   5          -0.3520       0.6149       TYPE(2)
[O]   6          -0.4406       0.6965       TYPE(3)
[O]   scale parameter taken as 2.504
[O]
[O] deviance = 83.819 (change = -3.820)
[O]   d.f. = 34      (change = -1      )
[O]
[O]           estimate      s.e.      parameter
[O]   1           4.887        1.054        1
[O]   2           0.5854       0.2367       LDTO
[O]   3          -0.2170       1.031       TRAP(2)
[O]   4           0.5529       0.8862       TRAP(3)
[O]   5          -0.2645       0.6142       TYPE(2)
[O]   6          -0.6632       0.7139       TYPE(3)
[O]   7          -0.8944       0.7185       CAT(2)
[O]   scale parameter taken as 2.465
[O]
[O] deviance = 74.631 (change = -9.189)
[O]   d.f. = 31      (change = -3      )
[O]
[O]           estimate      s.e.      parameter
[O]   1           4.170        1.290        1
[O]   2           0.7216       0.2446       LDTO
[O]   3           0.3633       1.169       TRAP(2)
[O]   4           0.8052       0.9208       TRAP(3)
[O]   5          -0.04226      0.7100       TYPE(2)
[O]   6          -0.03710      0.8785       TYPE(3)
[O]   7           -2.185        1.044       CAT(2)
[O]   8          -0.2340        1.385       FOOD(2)
[O]   9           1.836         0.9912      FOOD(3)
[O]  10           0.5128        0.8162      FOOD(4)
[O]   scale parameter taken as 2.407
[O]
[i] ? $stop$

```

APPENDIX 7

LINEAR REGRESSION/ANCOVA

TOTAL FEL D 1 VS TOTAL SIEVED DUST

```

[o] GLIM 3.77 update 1 (copyright)1985 Royal Statistical Society, London
[o]
[i] ? $input 12$
[i] File name? a:vac2.doc
[i] $subfile a:vac2.doc
[i] $units 41$
[i] !This is a data set of all vacuum samples which were collected then
[i] !determined to have sufficient mass to be analyzed by the DACI Lab.
[i] !dtot = the total mass of dust removed from the filter. mngg= mass of
[i] !Der f I mite allergen in nanograms per gram of total dust. cngg= mass
[i] !of Fel d I cat allergen in nanograms per gram of total dust. time=
[i] !sample collection time in minutes. area= the area of surface vacuumed
[i] !in square feet. type= tpe of surface; 1 is carpet 2 is sofa or chair
[i] !3 is mattress or pillow. trap = a number to scale from 1 to 3 to indic
[i] !the thickness/depth combination of the source/surface. no = the sample
[i] $data no dtot mngg cngg time area type trap cat food$
[i] $read
[i] 1 0.328 767 97 8 115.1 3 3 1 1
[i] 2 0.245 1156 57 8 60 1 3 1 1
[i] 3 0.227 118 997 7 19 3 3 1 1
[i] 4 0.227 116 132 7 52.7 1 2 1 1
[i] 5 0.621 60 563 5 37.5 2 2 1 2
[i] 6 0.063 247 25 5 47 1 2 1 2
[i] 7 0.159 25 157 8 37.5 3 3 1 1
[i] 8 0.179 25 557 6 40 1 2 1 1
[i] 9 0.135 54 2323180 6 17.1 2 3 2 3
[i] 10 0.034 70 264397 10 33.8 1 1 2 3
[i] 11 0.696 318 3323 8.5 23.125 2 3 1 4
[i] 12 0.099 222 2281 7.5 14.6 1 3 1 4
[i] 13 0.247 1167 202 7 76.7 3 3 1 1
[i] 14 0.338 168 97 4.5 9.5 3 1 1 1
[i] 15 0.621 175 228 5 12.75 1 3 1 1
[i] 16 0.886 25 25 5 12 1 3 1 4
[i] 17 0.083 25 207 4 8.7 1 3 1 4
[i] 18 0.322 373 25 5 6.4 2 3 1 4
[i] 19 0.087 836 8777972 4 4.3 2 3 2 3
[i] 20 0.024 5718 1830677 5 9.9 1 2 2 3
[i] 21 0.068 301 613 5 13 2 3 1 4
[i] 22 1.302 513 229 7 19.4 1 3 1 4
[i] 23 0.393 208 124 7 12.8 1 3 1 3
[i] 24 0.020 205 25 4.5 20.25 3 1 1 3
[i] 25 0.219 20886 57 8 22.3 1 3 1 3
[i] 26 0.034 3183 25 4 11.9 1 2 1 3
[i] 27 0.038 201 25 4 26.2 3 3 1 1
[i] 28 0.949 62 1350 7.5 23.8 2 2 1 2
[i] 29 0.145 115 25 9 19.0 3 3 1 1
[i] 30 0.148 371 152 7 38.4 3 3 1 1
[i] 32 0.152 59 3134314 4 8.2 2 3 2 3
[i] 33 1.029 25 147843 4 6.0 1 2 2 3
[i] 34 0.372 25 114042 4.5 6.1 1 2 2 3
[i] 35 0.036 548 25 7 6.4 2 3 1 4
[i] 36 0.992 190 305 5 9.0 1 3 1 1
[i] 37 0.040 125 514 6 18.1 3 1 1 1
[i] 39 0.180 976 25 5 7.8 3 1 1 4
[i] 41 0.3138 1233 1051 9 11.3 2 3 1 4
[i] 42 0.2433 1657 461 8 11.7 1 3 1 4
[i] 44 0.4155 292 298 6 8.9 2 3 1 4
[i] 45 1.3827 454 25 6 10.3 1 3 1 4

```

```

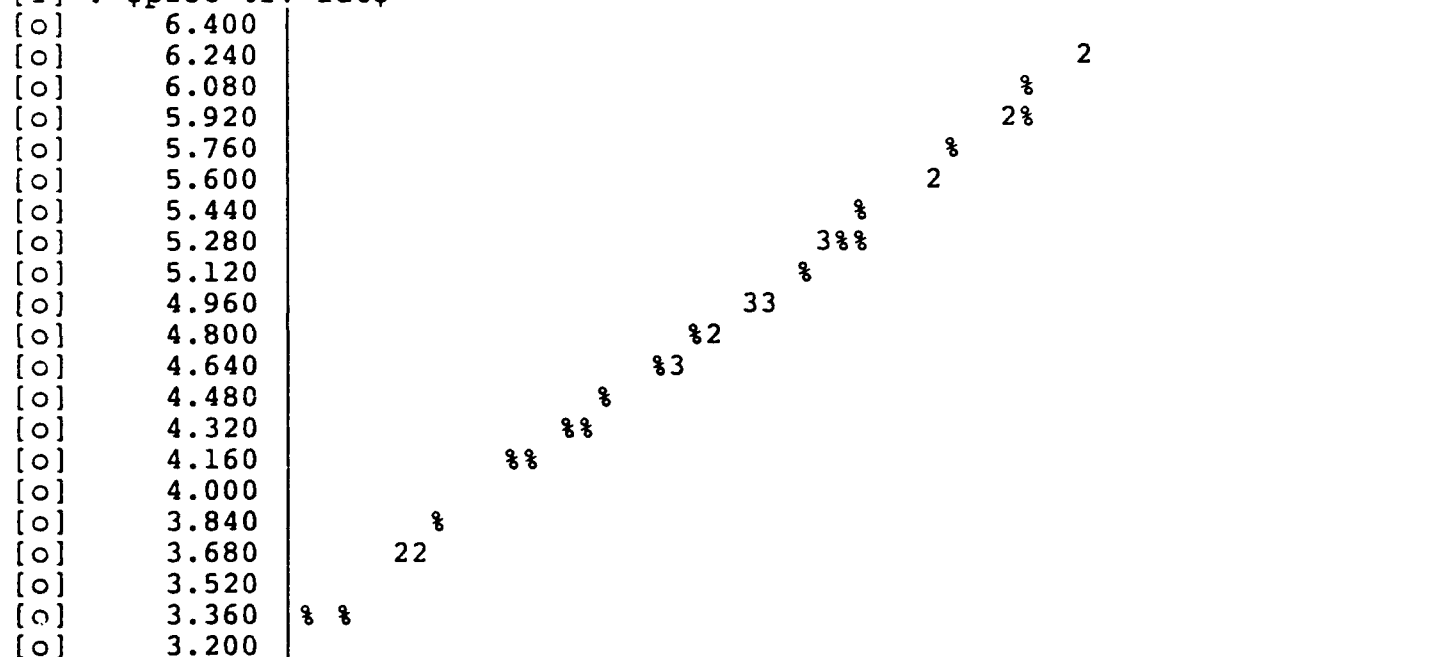
[i]
[i] $finish$
[i] ? $calc ctot=cngg*dtot$calc lct=%log ctot$calc ldt=%log dtot$
[i] ? $plot ctot dtot$
[o] 800000.
[o] 760000. C
[o] 720000.
[o] 680000.
[o] 640000.
[o] 600000.
[o] 560000.
[o] 520000.
[o] 480000. C
[o] 440000.
[o] 400000.
[o] 360000.
[o] 320000. C
[o] 280000.
[o] 240000.
[o] 200000.
[o] 160000. C
[o] 120000.
[o] 80000.
[o] 40000. C
[o] 0. C 622 32C5 C3 CC 2 C C CC C C
-----:-----:-----:-----:-----:-----:
[o] 0.000 0.300 0.600 0.900 1.200 1.500 1.800
[i] ? $plot lct ldt$
[o] 14.400
[o] 13.600 L
[o] 12.800 LL
[o] 12.000 L
[o] 11.200
[o] 10.400 L
[o] 9.600
[o] 8.800 L
[o] 8.000
[o] 7.200 L
[o] 6.400 L
[o] 5.600 L L L L L L L
[o] 4.800 L L L L L L L
[o] 4.000 L L L L L L L
[o] 3.200 L L LL L 2 L L
[o] 2.400 LL LL L
[o] 1.600 L L
[o] 0.800 L
[o] 0.000 L2
[o] -0.800 L
[o] -1.600
-----:-----:-----:-----:-----:
[o] -4.00 -3.00 -2.00 -1.00 0.00 1.00 2.00
[i] ? $yvar lct$fac type 3$fac trap 3$fac cat 2$fac food 4$error n$link i$
[i] ? $fit %gm$dis e$fit +ldt$dis e$
[o] deviance = 550.42
[o] d.f. = 40
[o]
[o] estimate s.e. parameter
[o] 1 4.872 0.5793 1

```

```

[o] scale parameter taken as 13.76
[o]
[o] deviance = 525.49 (change = -24.93)
[o] d.f. = 39 (change = -1 )
[o]
[o] estimate s.e. parameter
[o] 1 5.989 1.001 1
[o] 2 0.6854 0.5039 LDT
[o] scale parameter taken as 13.47
[o]
[i] ? !Slope is not significant -overlaps zero
[i] ? $calc res=lct-%fv$calc sre=res/%sqrt(%sc)$hist sre$
[o] [-1.60,-0.80) 8 SSSSSSSS
[o] [-0.80, 0.00) 20 SSSSSSSSSSSSSSSSSSSSSSS
[o] [ 0.00, 0.80) 6 SSSSSS
[o] [ 0.80, 1.60) 2 SS
[o] [ 1.60, 2.40) 4 SSSS
[o] [ 2.40, 3.20] 1 S
[i] ? $plot %fv ldt$

```



```

[o] -----:-----:-----:-----:-----:-----:-----:
[o] -4.00 -3.00 -2.00 -1.00 0.00 1.00 2.00
[i] ? $fit +trap$dis e$fit +type$dis e$fit +cat$dis e$fit +food$dis e$
[o] deviance = 507.26 (change = -18.23)
[o] d.f. = 37 (change = -2 )
[o]
[o] estimate s.e. parameter
[o] 1 4.913 2.195 1
[o] 2 0.6112 0.5414 LDT
[o] 3 2.141 2.141 TRAP(2)
[o] 4 0.7362 1.920 TRAP(3)
[o] scale parameter taken as 13.71
[o]
[o] deviance = 423.49 (change = -83.78)
[o] d.f. = 35 (change = -2 )
[o]
[o] estimate s.e. parameter
[o] 1 6.367 2.307 1

```

```

[o]      2      0.5239      0.5138      LDT
[o]      3      0.06038      2.284      TRAP(2)
[o]      4      -1.025      1.943      TRAP(3)
[o]      5      2.184      1.352      TYPE(2)
[o]      6      -2.109      1.531      TYPE(3)
[o]      scale parameter taken as 12.10
[o]
[o] deviance = 71.922 (change = -351.6)
[o]      d.f. = 34      (change = -1 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      4.443      0.9760      1
[o]      2      1.087      0.2192      LDT
[o]      3      0.2235      0.9553      TRAP(2)
[o]      4      0.4842      0.8209      TRAP(3)
[o]      5      1.344      0.5689      TYPE(2)
[o]      6      0.02706      0.6613      TYPE(3)
[o]      7      8.580      0.6656      CAT(2)
[o]      scale parameter taken as 2.115
[o]
[o] deviance = 65.832 (change = -6.090)
[o]      d.f. = 31      (change = -3 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      5.483      1.212      1
[o]      2      1.005      0.2298      LDT
[o]      3      -0.3770      1.098      TRAP(2)
[o]      4      0.1274      0.8648      TRAP(3)
[o]      5      1.422      0.6668      TYPE(2)
[o]      6      -0.7398      0.8251      TYPE(3)
[o]      7      9.178      0.9804      CAT(2)
[o]      8      -0.4621      1.301      FOOD(2)
[o]      9      -1.431      0.9309      FOOD(3)
[o]      10     -0.9702      0.7666      FOOD(4)
[o]      scale parameter taken as 2.124
[o]
[i] ? !When presence of a cat is accounted for, the slope becomes significant
[i] ? $stop$

```

APPENDIX 8

ANOVAS FOR DER F 1

```

[i] ? $yvar lmsf$fac type 3$error n$link i$fit %gm$dis e$
[w] -- model changed
[o] deviance = 147.78
[o] d.f. = 40
[o]
[o] estimate s.e. parameter
[o] 1 1.021 0.3002 1
[o] scale parameter taken as 3.694
[o]

```

```

[i] ? $fit +type$dis e$tab the lmsf mean for type$
[o] deviance = 135.19 (change = -12.59)
[o] d.f. = 38 (change = -2 )
[o]
[o] estimate s.e. parameter
[o] 1 1.303 0.4327 1
[o] 2 0.1403 0.7146 TYPE(2)
[o] 3 -1.193 0.7146 TYPE(3)
[o] scale parameter taken as 3.558
[o]

```

```

[o] 1 2 3
[o] [] 1.3033 1.4436 0.1108
[i] ? $yvar mta$error n$link i$fac type 3$fit %gm$dis e$fit +type$dis e$
[w] -- model changed
[o] deviance = 743.85
[o] d.f. = 40
[o]

```

```

[o] estimate s.e. parameter
[o] 1 2.044 0.6735 1
[o] scale parameter taken as 18.60
[o]

```

```

[o] deviance = 697.19 (change = -46.66)
[o] d.f. = 38 (change = -2 )
[o]

```

```

[o] estimate s.e. parameter
[o] 1 3.140 0.9827 1
[o] 2 -1.612 1.623 TYPE(2)
[o] 3 -2.475 1.623 TYPE(3)
[o] scale parameter taken as 18.35
[o]

```

```

[i] ? $tab the mta mean for type$

```

```

[o] 1 2 3
[o] [] 3.1404 1.5284 0.6658

```

```

[i] ? !type 1 is carpet, 2 is sofa/chair, and 3 is mattress/bed pillow.
[i] ? !This indicates that there is significantly more Der f 1 in carpet
[i] ? !than in sofa/chair or bedding in these study sites.

```

```

[i] ?
[i] ? $yvar mta$fac food 4$error n$link i$fit %gm$dis e$fit +food$dis e$
[w] -- model changed
[o] deviance = 743.85
[o] d.f. = 40
[o]
[o] estimate s.e. parameter
[o] 1 2.044 0.6735 1
[o] scale parameter taken as 18.60
[o]
[o] deviance = 679.07 (change = -64.78)
[o] d.f. = 37 (change = -3 )
[o]
[o] estimate s.e. parameter
[o] 1 0.6676 1.145 1
[o] 2 -0.4695 2.726 FOOD(2)
[o] 3 2.754 1.726 FOOD(3)
[o] 4 2.119 1.650 FOOD(4)
[o] scale parameter taken as 18.35
[o]
[i] ? $tab the mta mean for food$
[o] 1 2 3 4
[o] [] 0.6676 0.1982 3.4212 2.7868
[i] ? $fit -%gm$dis e$
[o] deviance = 679.07 (change = 0.)
[o] d.f. = 37 (change = 0 )
[o]
[o] estimate s.e. parameter
[o] 1 0.6676 1.145 FOOD(1)
[o] 2 0.1982 2.473 FOOD(2)
[o] 3 3.421 1.292 FOOD(3)
[o] 4 2.787 1.188 FOOD(4)
[o] scale parameter taken as 18.35
[o]
[i] ? $yvar msf$fac food 4$error n$link i$fit %gm$dis e$fit +food$dis e$
[w] -- model changed
[o] deviance = 44313.
[o] d.f. = 40
[c]
[o] estimate s.e. parameter
[o] 1 13.43 5.198 1
[o] scale parameter taken as 1108.
[o]
[o] deviance = 41108. (change = -3206.)
[o] d.f. = 37 (change = -3 )
[o]
[o] estimate s.e. parameter
[o] 1 3.651 8.908 1
[o] 2 -2.385 21.21 FOOD(2)
[o] 3 19.89 13.43 FOOD(3)
[o] 4 14.57 12.84 FOOD(4)
[o] scale parameter taken as 1111.
[o]
[i] ? $fit -%gm$dis e$
[o] deviance = 41108. (change = 0.)
[o] d.f. = 37 (change = 0 )
[o]
[o] estimate s.e. parameter

```

```

[o]      1      3.651      8.908      FOOD(1)
[o]      2      1.266      19.24      FOOD(2)
[o]      3      23.54      10.05      FOOD(3)
[o]      4      18.22      9.245      FOOD(4)
[o]      scale parameter taken as 1111.
[o]
[i] ? $tab the msf mean for food$
[o]      1      2      3      4
[o]      []      3.651      1.266      23.543      18.216
[i] ? $yvar msf$fac food 4$fac type 3$error n$link i$fit %gm$dis e$
[w] -- model changed
[o] deviance = 44313.
[o]      d.f. =      40
[o]
[o]      estimate      s.e.      parameter
[o]      1      13.43      5.198      1
[o]      scale parameter taken as 1108.
[o]
[i] ? $fit +food.type$dis e$
[o] deviance = 38503. (change = -5810.)
[o]      d.f. =      31 (change =      -9 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      6.960      15.76      1
[o]      2      0.000      aliased      FOOD(1).TYPE(2)
[o]      3      -5.147      19.66      FOOD(1).TYPE(3)
[o]      4      -6.628      38.61      FOOD(2).TYPE(1)
[o]      5      -5.227      29.49      FOOD(2).TYPE(2)
[o]      6      0.000      aliased      FOOD(2).TYPE(3)
[o]      7      27.37      20.64      FOOD(3).TYPE(1)
[o]      8      -0.8147      25.74      FOOD(3).TYPE(2)
[o]      9      -6.757      38.61      FOOD(3).TYPE(3)
[o]      10      15.28      21.34      FOOD(4).TYPE(1)
[o]      11      6.518      21.34      FOOD(4).TYPE(2)
[o]      12      15.56      38.61      FOOD(4).TYPE(3)
[o]      scale parameter taken as 1242.
[o]
[i] ? $fit -%gm$dis e$
[o] deviance = 38503. (change = 0.)
[o]      d.f. =      31 (change = 0 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      6.960      15.76      FOOD(1).TYPE(1)
[o]      2      0.000      aliased      FOOD(1).TYPE(2)
[o]      3      1.812      11.75      FOOD(1).TYPE(3)
[o]      4      0.3311      35.24      FOOD(2).TYPE(1)
[o]      5      1.733      24.92      FOOD(2).TYPE(2)
[o]      6      0.000      aliased      FOOD(2).TYPE(3)
[o]      7      34.33      13.32      FOOD(3).TYPE(1)
[o]      8      6.145      20.35      FOOD(3).TYPE(2)
[o]      9      0.2025      35.24      FOOD(3).TYPE(3)
[o]      10      22.24      14.39      FOOD(4).TYPE(1)
[o]      11      13.48      14.39      FOOD(4).TYPE(2)
[o]      12      22.52      35.24      FOOD(4).TYPE(3)
[o]      scale parameter taken as 1242.
[o]
[i] ? !The only one that is significant is some food with carpet.
[i]

```

```

[i] ? $stab the msf mean for food;type$
[w] -- the table contains empty cell(s)
[o]      1      2      3
[o]      1      6.9595      0.0000      1.8125
[o]      2      0.3311      1.7329      0.0000
[o]      3      34.3341      6.1448      0.2025
[o]      4      22.2370      13.4778      22.5231
[i] ? $yvar mta$fac food 4$fac type 3$error n$link i$fit %gm$dis e$
[w] -- model changed
[o] deviance = 743.85
[o]      d.f. = 40
[o]
[o]      estimate      s.e.      parameter
[o]      1      2.044      0.6735      1
[o]      scale parameter taken as 18.60
[o]
[i] ? $fit +food.type$fit -%gm$dis e$stab the mta mean for food;type$
[o] deviance = 632.91 (change = -110.9)
[o]      d.f. = 31      (change = -9 )
[o]
[o] deviance = 632.91 (change = 0.)
[o]      d.f. = 31      (change = 0 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      1.315      2.021      FOOD(1).TYPE(1)
[o]      2      0.000      aliased      FOOD(1).TYPE(2)
[o]      3      0.3082      1.506      FOOD(1).TYPE(3)
[o]      4      0.06622      4.518      FOOD(2).TYPE(1)
[o]      5      0.2642      3.195      FOOD(2).TYPE(2)
[o]      6      0.000      aliased      FOOD(2).TYPE(3)
[o]      7      4.716      1.708      FOOD(3).TYPE(1)
[o]      8      1.524      2.609      FOOD(3).TYPE(2)
[o]      9      0.04499      4.518      FOOD(3).TYPE(3)
[o]      10      3.335      1.845      FOOD(4).TYPE(1)
[o]      11      1.952      1.845      FOOD(4).TYPE(2)
[o]      12      4.505      4.518      FOOD(4).TYPE(3)
[o]      scale parameter taken as 20.42
[o]
[w] -- the table contains empty cell(s)
[o]      1      2      3
[o]      1      1.31464      0.00000      0.30819
[o]      2      0.06622      0.26417      0.00000
[o]      3      4.71645      1.52436      0.04499
[o]      4      3.33547      1.95184      4.50462
[i] ? !Same finding as before
[i] ? $yvar msf$fac trap 3$error n$link i$fit %gm$dis e$fit +trap$dis e$
[w] -- model changed
[o] deviance = 44313.
[o]      d.f. = 40
[o]
[o]      estimate      s.e.      parameter
[o]      1      13.43      5.198      1
[o]      scale parameter taken as 1108.

```

```

[o]
[o] deviance = 42582. (change = -1731.)
[o]   d.f. =    38 (change =    -2 )
[o]
[o]           estimate      s.e.      parameter
[o]   1           5.810      14.97      1
[o]   2          -2.124      18.67      TRAP(2)
[o]   3           12.28      16.30      TRAP(3)
[o]   scale parameter taken as 1121.
[o]
[i] ? $fit -%gm$dis e$
[o] deviance = 42582. (change = 0.)
[o]   d.f. =    38 (change = 0 )
[o]
[o]           estimate      s.e.      parameter
[o]   1           5.810      14.97      TRAP(1)
[o]   2           3.686      11.16      TRAP(2)
[o]   3           18.09      6.442     TRAP(3)
[o]   scale parameter taken as 1121.
[o]
[i] ? $tab the msf mean for trap$
[o]           1           2           3
[o]   []      5.810      3.686      18.091
[i] ? $yvar msf$fac trap 3$fac food 4$error n$link i$fit %gm$dis e$
[w] -- model changed
[o] deviance = 44313.
[o]   d.f. =    40
[o]
[o]           estimate      s.e.      parameter
[o]   1          13.43      5.198      1
[o]   scale parameter taken as 1108.
[o]
[i] ? $fit +trap.food$fit -%gm$dis e$tab the msf mean for trap;food$
[o] deviance = 36375. (change = -7938.)
[o]   d.f. =    32 (change =    -8 )
[o]
[o] deviance = 36375. (change = 0.)
[o]   d.f. =    32 (change = 0 )
[o]
[o]           estimate      s.e.      parameter
[o]   1           3.127      23.84      TRAP(1).FOOD(1)
[o]   2           0.000      aliased     TRAP(1).FOOD(2)
[o]   3           0.1364     23.84      TRAP(1).FOOD(3)
[o]   4           22.52      33.72      TRAP(1).FOOD(4)
[o]   5           0.3058     23.84      TRAP(2).FOOD(1)
[o]   6           1.266      19.47      TRAP(2).FOOD(2)
[o]   7           7.192      16.86      TRAP(2).FOOD(3)
[o]   8           0.000      aliased     TRAP(2).FOOD(4)
[o]   9           4.424      10.66      TRAP(3).FOOD(1)
[o]   10          0.000      aliased     TRAP(3).FOOD(2)
[o]   11          45.99      15.08      TRAP(3).FOOD(3)
[o]   12          17.86      9.733      TRAP(3).FOOD(4)
[o]   scale parameter taken as 1137.
[o]
[w] -- the table contains empty cell(s)
[o]           1           2           3           4
[o]   1      3.1268      0.0000      0.1364      22.5231
[o]   2      0.3058      1.2656      7.1920      0.0000

```

```

[o]      3      4.4245      0.0000      45.9869      17.8574
[i] ? $yvar msf$fac trap 3$fac type 3$error n$link i$fit %gm$dis e$
[w] -- model changed
[o] deviance = 44313.
[o]      d.f. =      40
[o]
[o]           estimate           s.e.      parameter
[o]      1           13.43           5.198           1
[o]      scale parameter taken as 1108.
[o]
[i] ? $fit +trap.type$dis e$fit -%gm$dis e$tab the msf mean for trap;type$
[o] deviance = 37192. (change = -7121.)
[o]      d.f. =      34 (change =      -6 )
[o]
[o]           estimate           s.e.      parameter
[o]      1           0.07041           33.07           1
[o]      2           0.000           aliased      TRAP(1).TYPE(2)
[o]      3           7.174           36.98      TRAP(1).TYPE(3)
[o]      4           4.174           35.36      TRAP(2).TYPE(1)
[o]      5           1.662           40.51      TRAP(2).TYPE(2)
[o]      6           0.000           aliased      TRAP(2).TYPE(3)
[o]      7           34.39           34.54      TRAP(3).TYPE(1)
[o]      8           10.96           34.86      TRAP(3).TYPE(2)
[o]      9           1.367           35.36      TRAP(3).TYPE(3)
[o]      scale parameter taken as 1094.
[o]
[o] deviance = 37192. (change = 0.)
[o]      d.f. =      34 (change = 0 )
[o]
[o]           estimate           s.e.      parameter
[o]      1           0.07041           33.07      TRAP(1).TYPE(1)
[o]      2           0.000           aliased      TRAP(1).TYPE(2)
[o]      3           7.245           16.54      TRAP(1).TYPE(3)
[o]      4           4.244           12.50      TRAP(2).TYPE(1)
[o]      5           1.733           23.39      TRAP(2).TYPE(2)
[o]      6           0.000           aliased      TRAP(2).TYPE(3)
[o]      7           34.46           9.972      TRAP(3).TYPE(1)
[o]      8           11.03           11.02      TRAP(3).TYPE(2)
[o]      9           1.437           12.50      TRAP(3).TYPE(3)
[o]      scale parameter taken as 1094.
[o]
[w] -- the table contains empty cell(s)
[o]           1           2           3
[o]      1           0.070      0.000      7.245
[o]      2           4.244      1.733      0.000
[o]      3           34.464     11.033      1.437
[i] ? $yvar msf$fac food 4$fac type 3$fac trap 3$error n$link i$fit %gm$dis
[w] -- model changed
[o] deviance = 44313.
[o]      d.f. =      40
[o]
[o]           estimate           s.e.      parameter
[o]      1           13.43           5.198           1
[o]      scale parameter taken as 1108.
[o]
[i] ? $fit +trap.type.food$dis e$fit -%gm$dis e$
[o] deviance = 24030. (change = -20284.)
[o]      d.f. =      27 (change =      -13 )

```

	estimate	s.e.	parameter
1	1.437	11.28	1
2	0.000	aliased	TRAP(1).TYPE(1).FOOD(2)
3	-1.367	31.89	TRAP(1).TYPE(1).FOOD(3)
4	0.000	aliased	TRAP(1).TYPE(1).FOOD(4)
5	0.000	aliased	TRAP(1).TYPE(2).FOOD(1)
6	0.000	aliased	TRAP(1).TYPE(2).FOOD(2)
7	0.000	aliased	TRAP(1).TYPE(2).FOOD(3)
8	0.000	aliased	TRAP(1).TYPE(2).FOOD(4)
9	1.690	23.92	TRAP(1).TYPE(3).FOOD(1)
10	0.000	aliased	TRAP(1).TYPE(3).FOOD(2)
11	-1.234	31.89	TRAP(1).TYPE(3).FOOD(3)
12	21.09	31.89	TRAP(1).TYPE(3).FOOD(4)
13	-1.131	23.92	TRAP(2).TYPE(1).FOOD(1)
14	-1.106	31.89	TRAP(2).TYPE(1).FOOD(2)
15	5.755	18.70	TRAP(2).TYPE(1).FOOD(3)
16	0.000	aliased	TRAP(2).TYPE(1).FOOD(4)
17	0.000	aliased	TRAP(2).TYPE(2).FOOD(1)
18	0.2959	23.92	TRAP(2).TYPE(2).FOOD(2)
19	0.000	aliased	TRAP(2).TYPE(2).FOOD(3)
20	0.000	aliased	TRAP(2).TYPE(2).FOOD(4)
21	0.000	aliased	TRAP(2).TYPE(3).FOOD(1)
22	0.000	aliased	TRAP(2).TYPE(3).FOOD(2)
23	0.000	aliased	TRAP(2).TYPE(3).FOOD(3)
24	0.000	aliased	TRAP(2).TYPE(3).FOOD(4)
25	9.958	20.59	TRAP(3).TYPE(1).FOOD(1)
26	0.000	aliased	TRAP(3).TYPE(1).FOOD(2)
27	104.3	23.92	TRAP(3).TYPE(1).FOOD(3)
28	20.80	16.60	TRAP(3).TYPE(1).FOOD(4)
29	0.000	aliased	TRAP(3).TYPE(2).FOOD(1)
30	0.000	aliased	TRAP(3).TYPE(2).FOOD(2)
31	4.708	20.59	TRAP(3).TYPE(2).FOOD(3)
32	12.04	16.60	TRAP(3).TYPE(2).FOOD(4)
33	0.000	aliased	TRAP(3).TYPE(3).FOOD(1)
34	0.000	aliased	TRAP(3).TYPE(3).FOOD(2)
35	0.000	aliased	TRAP(3).TYPE(3).FOOD(3)
36	0.000	aliased	TRAP(3).TYPE(3).FOOD(4)

scale parameter taken as 890.0

deviance = 24030. (change = 0.)
d.f. = 27 (change = 0)

	estimate	s.e.	parameter
1	0.000	aliased	TRAP(1).TYPE(1).FOOD(1)
2	0.000	aliased	TRAP(1).TYPE(1).FOOD(2)
3	0.07041	29.83	TRAP(1).TYPE(1).FOOD(3)
4	0.000	aliased	TRAP(1).TYPE(1).FOOD(4)
5	0.000	aliased	TRAP(1).TYPE(2).FOOD(1)
6	0.000	aliased	TRAP(1).TYPE(2).FOOD(2)
7	0.000	aliased	TRAP(1).TYPE(2).FOOD(3)
8	0.000	aliased	TRAP(1).TYPE(2).FOOD(4)
9	3.127	21.09	TRAP(1).TYPE(3).FOOD(1)
10	0.000	aliased	TRAP(1).TYPE(3).FOOD(2)
11	0.2025	29.83	TRAP(1).TYPE(3).FOOD(3)
12	22.52	29.83	TRAP(1).TYPE(3).FOOD(4)
13	0.3058	21.09	TRAP(2).TYPE(1).FOOD(1)
14	0.3311	29.83	TRAP(2).TYPE(1).FOOD(2)

```

[ o ]      15      7.192      14.92      TRAP(2).TYPE(1).FOOD(3)
[ o ]      16      0.000      aliased    TRAP(2).TYPE(1).FOOD(4)
[ o ]      17      0.000      aliased    TRAP(2).TYPE(2).FOOD(1)
[ o ]      18      1.733      21.09      TRAP(2).TYPE(2).FOOD(2)
[ o ]      19      0.000      aliased    TRAP(2).TYPE(2).FOOD(3)
[ o ]      20      0.000      aliased    TRAP(2).TYPE(2).FOOD(4)
[ o ]      21      0.000      aliased    TRAP(2).TYPE(3).FOOD(1)
[ o ]      22      0.000      aliased    TRAP(2).TYPE(3).FOOD(2)
[ o ]      23      0.000      aliased    TRAP(2).TYPE(3).FOOD(3)
[ o ]      24      0.000      aliased    TRAP(2).TYPE(3).FOOD(4)
[ o ]      25      11.40      17.22      TRAP(3).TYPE(1).FOOD(1)
[ o ]      26      0.000      aliased    TRAP(3).TYPE(1).FOOD(2)
[ o ]      27      105.7      21.09      TRAP(3).TYPE(1).FOOD(3)
[ o ]      28      22.24      12.18      TRAP(3).TYPE(1).FOOD(4)
[ o ]      29      0.000      aliased    TRAP(3).TYPE(2).FOOD(1)
[ o ]      30      0.000      aliased    TRAP(3).TYPE(2).FOOD(2)
[ o ]      31      6.145      17.22      TRAP(3).TYPE(2).FOOD(3)
[ o ]      32      13.43      12.18      TRAP(3).TYPE(2).FOOD(4)
[ o ]      33      1.437      11.28      TRAP(3).TYPE(3).FOOD(1)
[ o ]      34      0.000      aliased    TRAP(3).TYPE(3).FOOD(2)
[ o ]      35      0.000      aliased    TRAP(3).TYPE(3).FOOD(3)
[ o ]      36      0.000      aliased    TRAP(3).TYPE(3).FOOD(4)
[ o ]      scale parameter taken as 890.0
[ o ]
[ i ] ? !There is interaction with some food, carpet and high trapping.
[ i ] ? $fit +food$fit +trap$fit +type$dis es
[ o ] deviance = 24030. (change = 0.)
[ o ]      d.f. =      27 (change = 0 )
[ o ]
[ o ] deviance = 24030. (change = 0.)
[ o ]      d.f. =      27 (change = 0 )
[ o ]
[ o ] deviance = 24030. (change = 0.)
[ o ]      d.f. =      27 (change = 0 )
[ o ]
[ o ]
[ o ]      estimate      s.e.      parameter
[ o ]      1      13.09      29.48      TRAP(1)
[ o ]      2      0.3058      21.09      TRAP(2)
[ o ]      3      11.40      17.22      TRAP(3)
[ o ]      4      7.764      41.94      TYPE(2)
[ o ]      5      -9.958      20.59      TYPE(3)
[ o ]      6      -6.337      51.47      FOOD(2)
[ o ]      7      -13.01      41.94      FOOD(3)
[ o ]      8      -5.682      46.94      FOOD(4)
[ o ]      9      0.000      aliased    TRAP(1).TYPE(2).FOOD(2)
[ o ]     10      0.000      aliased    TRAP(1).TYPE(2).FOOD(3)
[ o ]     11      0.000      aliased    TRAP(1).TYPE(2).FOOD(4)
[ o ]     12      0.000      aliased    TRAP(1).TYPE(3).FOOD(2)
[ o ]     13      10.09      46.94      TRAP(1).TYPE(3).FOOD(3)
[ o ]     14      25.08      51.47      TRAP(1).TYPE(3).FOOD(4)
[ o ]     15      6.362      55.62      TRAP(2).TYPE(1).FOOD(2)
[ o ]     16      19.90      49.26      TRAP(2).TYPE(1).FOOD(3)
[ o ]     17      0.000      aliased    TRAP(2).TYPE(1).FOOD(4)
[ o ]     18      0.000      aliased    TRAP(2).TYPE(2).FOOD(1)
[ o ]     19      0.000      aliased    TRAP(2).TYPE(2).FOOD(2)
[ o ]     20      0.000      aliased    TRAP(2).TYPE(2).FOOD(3)
[ o ]     21      0.000      aliased    TRAP(2).TYPE(2).FOOD(4)
[ o ]     22      0.000      aliased    TRAP(2).TYPE(3).FOOD(1)

```

```

[o] 23      0.000      aliased      TRAP(2).TYPE(3).FOOD(2)
[o] 24      0.000      aliased      TRAP(2).TYPE(3).FOOD(3)
[o] 25      0.000      aliased      TRAP(2).TYPE(3).FOOD(4)
[o] 26      0.000      aliased      TRAP(3).TYPE(1).FOOD(2)
[o] 27      107.4      43.67      TRAP(3).TYPE(1).FOOD(3)
[o] 28      16.52      45.34      TRAP(3).TYPE(1).FOOD(4)
[o] 29      0.000      aliased      TRAP(3).TYPE(2).FOOD(1)
[o] 30      0.000      aliased      TRAP(3).TYPE(2).FOOD(2)
[o] 31      0.000      aliased      TRAP(3).TYPE(2).FOOD(3)
[o] 32      0.000      aliased      TRAP(3).TYPE(2).FOOD(4)
[o] 33      0.000      aliased      TRAP(3).TYPE(3).FOOD(1)
[o] 34      0.000      aliased      TRAP(3).TYPE(3).FOOD(2)
[o] 35      0.000      aliased      TRAP(3).TYPE(3).FOOD(3)
[o] 36      0.000      aliased      TRAP(3).TYPE(3).FOOD(4)

```

```

[o] scale parameter taken as 890.0

```

```

[i] ? $stab the msf mean for food;trap;type$

```

```

[w] -- the table contains empty cell(s)

```

```

[o]      1      2      3
[o] 1 1      0.00000      0.00000      3.12675
[o]      2      0.30577      0.00000      0.00000
[o]      3      11.39536      0.00000      1.43696
[o]
[o] 2 1      0.00000      0.00000      0.00000
[o]      2      0.33109      1.73289      0.00000
[o]      3      0.00000      0.00000      0.00000
[o]
[o] 3 1      0.07041      0.00000      0.20247
[o]      2      7.19205      0.00000      0.00000
[o]      3      105.74994      6.14480      0.00000
[o]
[o] 4 1      0.00000      0.00000      22.52308
[o]      2      0.00000      0.00000      0.00000
[o]      3      22.23703      13.47782      0.00000

```

```

[i] ? $stab the lmsf mean for food;trap;type$

```

```

[w] -- the table contains empty cell(s)

```

```

[o]      1      2      3
[o] 1 1      0.0000      0.0000      0.2507
[o]      2     -1.4421      0.0000      0.0000
[o]      3      2.2455      0.0000     -0.1144
[o]
[o] 2 1      0.0000      0.0000      0.0000
[o]      2     -1.1054      0.4493      0.0000
[o]      3      0.0000      0.0000      0.0000
[o]
[o] 3 1     -2.6534      0.0000     -1.5972
[o]      2      1.6786      0.0000      0.0000
[o]      3      3.5889      0.6884      0.0000
[o]
[o] 4 1      0.0000      0.0000      3.1145
[o]      2      0.0000      0.0000      0.0000
[o]      3      1.7962      2.1527      0.0000

```

```

[i] ? $stab the mta mean for food;trap;type$

```

```

[w] -- the table contains empty cell(s)

```

```

[o]      1      2      3
[o] 1 1      0.000000      0.000000      0.687161
[o]      2      0.045013      0.000000      0.000000
[o]      3      2.161064      0.000000      0.199915

```

```

[o]
[o]      2 1      0.000000      0.000000      0.000000
[o]      2      0.066217      0.264172      0.000000
[o]      3      0.000000      0.000000      0.000000
[o]
[o]      3 1      0.007041      0.000000      0.044993
[o]      2      1.614152      0.000000      0.000000
[o]      3      13.275763      1.524357      0.000000
[o]
[o]      4 1      0.000000      0.000000      4.504616
[o]      2      0.000000      0.000000      0.000000
[o]      3      3.335466      1.951843      0.000000
[i] ? $tab the msf mean for cat$
[o]      1      2
[o]      [] 15.074      5.454
[i] ? $tab the mta mean for cat$
[o]      1      2
[o]      [] 2.207      1.252
[i] ? $yvar msf$fac cat 2$error n$link i$fit %gm$dis e$fit +cat$dis e$
[w] -- model changed
[o] deviance = 44313.
[o]      d.f. =      40
[o]
[o]      estimate      s.e.      parameter
[o]      1      13.43      5.198      1
[o]      scale parameter taken as 1108.
[o]
[o] deviance = 43776. (change = -537.2)
[o]      d.f. =      39 (change = -1 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      15.07      5.746      1
[o]      2      -9.620      13.91      CAT(2)
[o]      scale parameter taken as 1122.
[o]
[i] ? $fit -%gm$dis e$
[o] deviance = 43776. (change = 0.)
[o]      d.f. =      39 (change = 0 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      15.07      5.746      CAT(1)
[o]      2      5.454      12.66      CAT(2)
[o]      scale parameter taken as 1122.
[o]
[i] ? !cat = 1 means no cat present; ? means a cat is present
[i] ? !perhaps those with cats vacuum more frequently
[i] ? $yvar msf$fac cat 2$fac type 3$error n$link i$fit %gm$fit +cat.type$di
[w] -- model changed
[o] deviance = 44313.
[o]      d.f. =      40
[o]
[o] deviance = 40376. (change = -3937.)
[o]      d.f. =      36 (change = -4 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      25.94      8.647      1
[o]      2      -15.40      14.66      CAT(1).TYPE(2)
[o]      3      -22.39      13.29      CAT(1).TYPE(3)

```

```

[o]      4      -21.01      18.85      CAT(2).TYPE(1)
[o]      5      -19.80      21.18      CAT(2).TYPE(2)
[o]      6      0.000      aliased      CAT(2).TYPE(3)
[o]      scale parameter taken as 1122.
[o]
[i] ? $fit -%gm$dis e$
[o] deviance = 40376. (change = 0.)
[o] d.f. = 36 (change = 0 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      25.94      8.647      CAT(1).TYPE(1)
[o]      2      10.54      11.84      CAT(1).TYPE(2)
[o]      3      3.549      10.10      CAT(1).TYPE(3)
[o]      4      4.936      16.74      CAT(2).TYPE(1)
[o]      5      6.145      19.34      CAT(2).TYPE(2)
[o]      6      0.000      aliased      CAT(2).TYPE(3)
[o]      scale parameter taken as 1122.
[o]
[i] ? $yvar msf$fac cat 2$fac type 3$fac trap 3$fac food 4$error n$link i$fi
[w] -- model changed
[o] deviance = 44313.
[o] d.f. = 40
[o]
[i] ? $fit +cat.trap$dis e$
[o] deviance = 42022. (change = -2291.)
[o] d.f. = 35 (change = -5 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      7.245      17.33      1
[o]      2      -4.994      22.37      CAT(1).TRAP(2)
[o]      3      12.34      18.71      CAT(1).TRAP(3)
[o]      4      -7.174      38.74      CAT(2).TRAP(1)
[o]      5      -0.6868      26.46      CAT(2).TRAP(2)
[o]      6      -1.100      26.46      CAT(2).TRAP(3)
[o]      scale parameter taken as 1201.
[o]
[i] ? $fit -%gm$dis e$
[o] deviance = 42022. (change = 0.)
[o] d.f. = 35 (change = 0 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      7.245      17.33      CAT(1).TRAP(1)
[o]      2      2.250      14.15      CAT(1).TRAP(2)
[o]      3      19.58      7.073      CAT(1).TRAP(3)
[o]      4      0.07041      34.65      CAT(2).TRAP(1)
[o]      5      6.558      20.01      CAT(2).TRAP(2)
[o]      6      6.145      20.01      CAT(2).TRAP(3)
[o]      scale parameter taken as 1201.
[o]
[i] ? !It appears that there are interactions where the lack of a cat occurs
[i] ? !with high trapping and with carpet.
[i] ? $stop$

```

APPENDIX 9

ANOVAS FOR FEL D 1

```

[i] ?
[i] ? $yvar csf$fac cat 2$fac type 3$error n$link i$fit %gm$dis e$fit +type$
[o] deviance = 33894158336.
[o] d.f. = 40
[o]
[o] estimate s.e. parameter
[o] 1 7107. 4546. 1
[o] scale parameter taken as 847353920.
[o]
[o] deviance = 30015787008. (change = -3878371328.)
[o] d.f. = 38 (change = -2 )
[o]
[i] ? $dis e$
[o] estimate s.e. parameter
[o] 1 1953. 6448. 1
[o] 2 21160. 10648. TYPE(2)
[o] 3 -1952. 10648. TYPE(3)
[o] scale parameter taken as 789889152.
[o]

[i] ? $fit -%gm$dis e$tab the csf mean for cat;type$
[o] deviance = 30015787008. (change = 0.)
[o] d.f. = 38 (change = 0 )

```

```

[o]
[o]          estimate      s.e.      parameter
[o]      1          1953.      6448.      TYPE(1)
[o]      2          23114.      8474.      TYPE(2)
[o]      3           1.773      8474.      TYPE(3)
[o]      scale parameter taken as 789889152.
[o]
[w] -- the table contains empty cell(s)
[o]          1          2          3
[o]      1          6.673      26.359      1.773
[o]      2      9253.434      84680.398      0.000
[i] ? $fit +cat.type$dis e$
[o] deviance = 14110200832. (change = -1.591e+10)
[o]      d.f. =          36 (change =          -2 )
[o]
[o]          estimate      s.e.      parameter
[o]      1          6.673      5112.      TYPE(1)
[o]      2          26.36      7000.      TYPE(2)
[o]      3          1.773      5969.      TYPE(3)
[o]      4          9247.      11141.      TYPE(1).CAT(2)
[o]      5          84654.      13403.      TYPE(2).CAT(2)
[o]      6          0.000      aliased      TYPE(3).CAT(2)
[o]      scale parameter taken as 391950016.
[o]
[i] ? !Cats in this study seemed to prefer sofas/chairs. There is an intera
[i] ? $yvar lcta$fac cat 2$fac type 3$error n$link i$fit %gm$dis e$fit +type
[w] -- model changed
[o] deviance = 661.92
[o]      d.f. = 40
[o]
[o]          estimate      s.e.      parameter
[o]      1          0.2605      0.6353      1
[o]      scale parameter taken as 16.55
[o]
[o] deviance = 509.03 (change = -152.9)
[o]      d.f. = 38 (change = -2 )
[o]
[o]          estimate      s.e.      parameter
[o]      1          0.4765      0.8397      1
[o]      2          2.219      1.387      TYPE(2)
[o]      3          -3.024      1.387      TYPE(3)
[o]      scale parameter taken as 13.40
[o]
[i] ? $fit +cat$dis e$fit +cat.type$dis e$fit -%gm$dis e$
[o] deviance = 138.46 (change = -370.6)
[o]      d.f. = 37 (change = -1 )
[o]
[o]          estimate      s.e.      parameter
[o]      1          -1.277      0.4775      1
[o]      2          1.701      0.7347      TYPE(2)
[o]      3          -1.271      0.7538      TYPE(3)
[o]      4          8.331      0.8371      CAT(2)
[o]      scale parameter taken as 3.742
[o]
[o] deviance = 135.21 (change = -3.245)
[o]      d.f. = 36 (change = -1 )
[o]
[o]          estimate      s.e.      parameter

```

```

[o]      1      -1.141      0.5004      1
[o]      2       1.309      0.8485     TYPE(2)
[o]      3      -1.407      0.7693     TYPE(3)
[o]      4       7.683      1.091      CAT(2)
[o]      5       1.586      1.706     TYPE(2).CAT(2)
[o]      6       0.000      aliased    TYPE(3).CAT(2)
[o]      scale parameter taken as  3.756
[o]
[o] deviance = 135.21 (change = 0.)
[o]      d.f. = 36      (change = 0 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      -1.141      0.5004     TYPE(1)
[o]      2       0.1681      0.6852     TYPE(2)
[o]      3      -2.548      0.5843     TYPE(3)
[o]      4       7.683      1.091      CAT(2)
[o]      5       1.586      1.706     TYPE(2).CAT(2)
[o]      6       0.000      aliased    TYPE(3).CAT(2)
[o]      scale parameter taken as  3.756
[o]
[i] ? !With the logarithmic data of Fel d 1 per time*area, there is signific
[i] ? !for carpet, for mattress, for presence of a cat, but no interaction.
[i] ? $yvar lcsf$fac cat 2$fac type 3$error n$link i$fit %gm$dis e$fit +cat$
[w] -- model changed
[o] deviance = 641.99
[o]      d.f. = 40
[o]
[o]      estimate      s.e.      parameter
[o]      1       2.045      0.6257      1
[o]      scale parameter taken as 16.05
[o]
[o] deviance = 184.57 (change = -457.4)
[o]      d.f. = 39      (change = -1 )
[o]
[o]      estimate      s.e.      parameter
[o]      1       0.5293      0.3731      1
[o]      2       8.877      0.9029     CAT(2)
[o]      scale parameter taken as  4.733
[o]
[i] ? $fit +type$dis e$fit +type.cat$dis e$fit -%gm$dis e$
[o] deviance = 138.45 (change = -46.12)
[o]      d.f. = 37      (change = -2 )
[o]
[o]      estimate      s.e.      parameter
[o]      1       0.5366      0.4775      1
[o]      2       8.136      0.8371     CAT(2)
[o]      3       1.711      0.7347     TYPE(2)
[o]      4      -1.267      0.7538     TYPE(3)
[o]      scale parameter taken as  3.742
[o]
[o] deviance = 136.15 (change = -2.297)
[o]      d.f. = 36      (change = -1 )
[o]
[o]      estimate      s.e.      parameter
[o]      1       0.6514      0.5021      1
[o]      2       7.591      1.094      CAT(2)
[o]      3       1.381      0.8514     TYPE(2)
[o]      4      -1.382      0.7720     TYPE(3)

```

```

[o]      5      1.334      1.712      CAT(2).TYPE(2)
[o]      6      0.000      aliased      CAT(2).TYPE(3)
[o]      scale parameter taken as 3.782
[o]
[o] deviance = 136.15 (change = 0.)
[o]      d.f. = 36      (change = 0 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      0.6514      0.5021      CAT(1)
[o]      2      8.242      0.9724      CAT(2)
[o]      3      1.381      0.8514      TYPE(2)
[o]      4      -1.382      0.7720      TYPE(3)
[o]      5      1.334      1.712      CAT(2).TYPE(2)
[o]      6      0.000      aliased      CAT(2).TYPE(3)
[o]      scale parameter taken as 3.782
[o]
[i] ? !Find just presence of a cat to be significant with Fel d 1 per sq ft
[i] ? $yvar csf$fac cat 2$fac type 3$error n$link i$fit %gm$dis e$fit +cat$d
[w] -- model changed
[o] deviance = 33894158336.
[o]      d.f. = 40
[o]
[o]      estimate      s.e.      parameter
[o]      1      7107.      4546.      1
[o]      scale parameter taken as 847353920.
[o]
[o] deviance = 23863164928. (change = -1.003e+10)
[o]      d.f. = 39      (change = -1 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      9.720      4242.      1
[o]      2      41570.      10267.      CAT(2)
[o]      scale parameter taken as 611876032.
[o]
[i] ? $fit +type$dis e$fit +type.cat$dis e$fit -%gm$dis e$
[o] deviance = 21447307264. (change = -2415857664.)
[o]      d.f. = 37      (change = -2 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      -6480.      5943.      1
[o]      2      40058.      10419.      CAT(2)
[o]      3      18669.      9145.      TYPE(2)
[o]      4      6482.      9382.      TYPE(3)
[o]      scale parameter taken as 579656960.
[o]
[o] deviance = 14110200832. (change = -7337106432.)
[o]      d.f. = 36      (change = -1 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      6.673      5112.      1
[o]      2      9247.      11141.      CAT(2)
[o]      3      19.69      8667.      TYPE(2)
[o]      4      -4.899      7859.      TYPE(3)
[o]      5      75407.      17429.      CAT(2).TYPE(2)
[o]      6      0.000      aliased      CAT(2).TYPE(3)
[o]      scale parameter taken as 391950016.
[o]
[o] deviance = 14110200832. (change = 0.)

```

```

[o]      d.f. =          36  (change =  0 )
[o]
[o]      estimate      s.e.      parameter
[o]      1          6.673      5112.      CAT(1)
[o]      2          9253.      9899.      CAT(2)
[o]      3          19.69      8667.      TYPE(2)
[o]      4          -4.899      7859.      TYPE(3)
[o]      5          75407.      17429.      CAT(2).TYPE(2)
[o]      6           0.000      aliased     CAT(2).TYPE(3)
[o]      scale parameter taken as  391950016.
[o]
[i] ? !For straight Fel d 1 per sq ft there is a relationship with only an
[i] ? !interaction between cats present and sofa/chair.
[i] ? $yvar cta$fac cat 2 fac type 3$error n$link i$fit %gm$dis e$
[w] -- model changed
[o] deviance = 2112696448.
[o]      d.f. =          40
[o]
[o]      estimate      s.e.      parameter
[o]      1          1728.      1135.      1
[o]      scale parameter taken as  52817412.
[o]
[o] deviance = 1519357696. (change = -593338752.)
[o]      d.f. =          39  (change =      -1 )
[o]

```

```

[i] ? $fit +cat$dis e$fit +type$dis e$fit +cat.type$dis e$fit -%gm$dis e$
[o] deviance = 1519357696. (change =  0.)
[o]      d.f. =          39  (change =  0 )
[o]
[o]      estimate      s.e.      parameter
[o]      1          1.393      1070.      1
[o]      2          10110.      2591.      CAT(2)
[o]      scale parameter taken as  38957892.
[o]
[o] deviance = 1374758656. (change = -144599040.)
[o]      d.f. =          37  (change =      -2 )
[o]
[o]      estimate      s.e.      parameter
[o]      1          -1587.      1505.      1
[o]      2           9741.      2638.      CAT(2)
[o]      3           4567.      2315.      TYPE(2)
[o]      4           1587.      2375.      TYPE(3)
[o]      scale parameter taken as  37155640.
[o]
[o] deviance = 935113408. (change = -439645248.)
[o]      d.f. =          36  (change =      -1 )
[o]
[o]      estimate      s.e.      parameter
[o]      1          1.132      1316.      1
[o]      2          2198.      2868.      CAT(2)
[o]      3          2.278      2231.      TYPE(2)
[o]      4          -0.8503      2023.      TYPE(3)

```

```

[o]      5      18459.      4487.      CAT(2).TYPE(2)
[o]      6      0.000      aliased      CAT(2).TYPE(3)
[o]      scale parameter taken as 25975372.
[o]
[o] deviance = 935113408. (change = 0.)
[o]      d.f. =      36 (change = 0 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      1.132      1316.      CAT(1)
[o]      2      2200.      2548.      CAT(2)
[o]      3      2.278      2231.      TYPE(2)
[o]      4      -0.8503      2023.      TYPE(3)
[o]      5      18459.      4487.      CAT(2).TYPE(2)
[o]      6      0.000      aliased      CAT(2).TYPE(3)
[o]      scale parameter taken as 25975372.
[o]
[i] ? !With straight Fel d 1 per sf*min there is only significance with the
[i] ? !interaction between having a cat and sofa/chair.
[i] ? $stab the cta mean for cat;type$
[w] -- the table contains empty cell(s)
[o]      1      2      3
[o]      1      1.1325      3.4103      0.2821
[o]      2      2199.6133      20660.6309      0.0000
[i] ? $yvar cta$fac cat 2$fac trap 3$error n$link i$fit %gm$dis e$fit +cat$d
[w] -- model changed
[o] deviance = 2112696448.
[o]      d.f. =      40
[o]
[o]      estimate      s.e.      parameter
[o]      1      1728.      1135.      1
[o]      scale parameter taken as 52817412.
[o]
[o] deviance = 1519357696. (change = -593338752.)
[o]      d.f. =      39 (change = -1 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      1.393      1070.      1
[o]      2      10110.      2591.      CAT(2)
[o]      scale parameter taken as 38957892.
[o]
[i] ? $fit +trap$dis e$fit -%gm$dis e$stab the cta mean for cat;trap$fit +cat
[o] deviance = 1404322432. (change = -115035264.)
[o]      d.f. =      37 (change = -2 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      -2225.      2805.      1
[o]      2      11151.      2635.      CAT(2)
[o]      3      -516.6      3454.      TRAP(2)
[o]      4      3283.      3009.      TRAP(3)
[o]      scale parameter taken as 37954660.
[o]
[o] deviance = 1404322432. (change = 0.)
[o]      d.f. =      37 (change = 0 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      -2225.      2805.      CAT(1)
[o]      2      8926.      3469.      CAT(2)
[o]      3      -516.6      3454.      TRAP(2)

```

```

[o]      4      3283.      3009.      TRAP(3)
[o]      scale parameter taken as 37954660.
[o]
[o]      1      2      3
[o]      1      0.269      1.594      1.531
[o]      2      26.596      2923.952      20660.631
[o] deviance = 928817408. (change = -475505024.)
[o]      d.f. =      35 (change =      -2 )
[o]
[i] ? $dis e$
[o]      estimate      s.e.      parameter
[o]      1      0.2693      2576.      CAT(1)
[o]      2      26.60      5151.      CAT(2)
[o]      3      1.325      3325.      TRAP(2)
[o]      4      1.261      2782.      TRAP(3)
[o]      5      2896.      6815.      CAT(2).TRAP(2)
[o]      6      20633.      6567.      CAT(2).TRAP(3)
[o]      scale parameter taken as 26537640.
[o]
[i] ? !There is an interaction between having a cat and high trapping of the
[i] ? $yvar csf$fac cat 2$fac trap 3$error n$link i$fit %gm$dis E$fit +cat$d
[w] -- model changed
[o] deviance = 33894158336.
[o]      d.f. =      40
[o]
[o]      estimate      s.e.      parameter
[o]      1      7107.      4546.      1
[o]      scale parameter taken as 847353920.
[o]
[o] deviance = 23863164928. (change = -1.003e+10)
[o]      d.f. =      39 (change =      -1 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      9.720      4242.      1
[o]      2      41570.      10267.      CAT(2)
[o]      scale parameter taken as 611876032.
[o]
[i] ? $fit +trap$dis e$fit +trap.cat$dis e$tab the csf mean for cat;trap$
[o] deviance = 21942988800. (change = -1920176128.)
[o]      d.f. =      37 (change =      -2 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      -9109.      11088.      1
[o]      2      45818.      10416.      CAT(2)
[o]      3      -2073.      13654.      TRAP(2)
[o]      4      13437.      11893.      TRAP(3)
[o]      scale parameter taken as 593053760.
[o]
[o] deviance = 14002504704. (change = -7940484096.)
[o]      d.f. =      35 (change =      -2 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      1.297      10001.      1
[o]      2      264.7      22363.      CAT(2)
[o]      3      9.756      12911.      TRAP(2)
[o]      4      9.493      10802.      TRAP(3)
[o]      5      11974.      26460.      CAT(2).TRAP(2)
[o]      6      84405.      25497.      CAT(2).TRAP(3)

```

```

[o] scale parameter taken as 400071552.
[o]
[o]      1      2      3
[o] 1      1.30    11.05    10.79
[o] 2     265.96  12249.26  84680.40
[i] ? !There is interaction between having a cat and high surface trapping.
[i] ? $yvar cta$fac food 4$fac cat 2$error n$link i$fit %gm$dis e$fit +cat$d
[w] -- model changed
[o] deviance = 2112696448.
[o] d.f. = 40
[o]
[o]      estimate      s.e.      parameter
[o] 1      1728.      1135.      1
[o] scale parameter taken as 52817412.
[o]
[o] deviance = 1519357696. (change = -593338752.)
[o] d.f. = 39 (change = -1 )
[o]
[o]      estimate      s.e.      parameter
[o] 1      1.393      1070.      1
[o] 2     10110.      2591.      CAT(2)
[o] scale parameter taken as 38957892.
[o]
[i] ? $fit +food$dis e$fit +food.cat$d$dis e$fit -%gm$dis E$
[o] deviance = 1519357696. (change = 0.)
[o] d.f. = 36 (change = -3 )
[o]
[o]      estimate      s.e.      parameter
[o] 1      0.8895      1736.      1
[o] 2     10111.      4072.      CAT(2)
[o] 3      2.127      4133.      FOOD(2)
[o] 4     -0.7302      3683.      FOOD(3)
[o] 5      1.052      2502.      FOOD(4)
[o] scale parameter taken as 42204380.
[o]
[o] deviance = 1519357696. (change = 0.)
[o] d.f. = 36 (change = 0 )
[o]
[o]      estimate      s.e.      parameter
[o] 1      0.8895      1736.      1
[o] 2     10111.      4072.      CAT(2)
[o] 3      2.127      4133.      FOOD(2)
[o] 4     -0.7302      3683.      FOOD(3)
[o] 5      1.052      2502.      FOOD(4)
[o] 6      0.000      aliased      CAT(2).FOOD(2)
[o] 7      0.000      aliased      CAT(2).FOOD(3)
[o] 8      0.000      aliased      CAT(2).FOOD(4)
[o] scale parameter taken as 42204380.
[o]
[o] deviance = 1519357696. (change = 0.)
[o] d.f. = 36 (change = 0 )
[o]
[o]      estimate      s.e.      parameter
[o] 1      0.8895      1736.      CAT(1)
[o] 2     10112.      4427.      CAT(2)
[o] 3      2.127      4133.      FOOD(2)
[o] 4     -0.7302      3683.      FOOD(3)
[o] 5      1.052      2502.      FOOD(4)

```

```

[o]      6      0.000      aliased      CAT(2).FOOD(2)
[o]      7      0.000      aliased      CAT(2).FOOD(3)
[o]      8      0.000      aliased      CAT(2).FOOD(4)
[o]      scale parameter taken as 42204380.
[o]

```

```

[i] ? !Presence of food is irrelevant to Fel d 1 presence
[i] ? $stab the csf mean for cat;food$
[w] -- the table contains empty cell(s)
[o]      1      2      3      4
[o]      1      4.780      21.062      1.116      15.069
[o]      2      0.000      0.000      41579.277      0.000
[i] ? $yvar cta$fac cat 2$fac trap 3$fac type 3$error n$link i$fit %gm$dis e
[w] -- model changed
[o] deviance = 2112696448.
[o]      d.f. =      40
[o]

```

```

[o]      estimate      s.e.      parameter
[o]      1      1728.      1135.      1
[o]      scale parameter taken as 52817412.
[o]

```

```

[i] ? $fit +cat.trap.type$dis e$fit -%gm$dis e$
[o] deviance = 928817344. (change = -1183879168.)
[o]      d.f. =      32 (change =      -8 )
[o]

```

```

[o]      estimate      s.e.      parameter
[o]      1      20661.      3110.      1
[o]      2      0.000      aliased      CAT(1).TRAP(1).TYPE(2)
[o]      3      -20660.      4115.      CAT(1).TRAP(1).TYPE(3)
[o]      4      -20661.      4115.      CAT(1).TRAP(2).TYPE(1)
[o]      5      -20656.      4918.      CAT(1).TRAP(2).TYPE(2)
[o]      6      0.000      aliased      CAT(1).TRAP(2).TYPE(3)
[o]      7      -20659.      3509.      CAT(1).TRAP(3).TYPE(1)
[o]      8      -20658.      3810.      CAT(1).TRAP(3).TYPE(2)
[o]      9      -20660.      3718.      CAT(1).TRAP(3).TYPE(3)
[o]      10      -20634.      6221.      CAT(2).TRAP(1).TYPE(1)
[o]      11      0.000      aliased      CAT(2).TRAP(1).TYPE(2)
[o]      12      0.000      aliased      CAT(2).TRAP(1).TYPE(3)
[o]      13      -17737.      4399.      CAT(2).TRAP(2).TYPE(1)
[o]      14      0.000      aliased      CAT(2).TRAP(2).TYPE(2)
[o]      15      0.000      aliased      CAT(2).TRAP(2).TYPE(3)
[o]      16      0.000      aliased      CAT(2).TRAP(3).TYPE(1)
[o]      17      0.000      aliased      CAT(2).TRAP(3).TYPE(2)
[o]      18      0.000      aliased      CAT(2).TRAP(3).TYPE(3)
[o]      scale parameter taken as 29025542.
[o]

```

```

[o] deviance = 928817344. (change = 0.)
[o]      d.f. =      32 (change = 0 )
[o]

```

```

[o]      estimate      s.e.      parameter
[o]      1      0.000      aliased      CAT(1).TRAP(1).TYPE(1)
[o]      2      0.000      aliased      CAT(1).TRAP(1).TYPE(2)
[o]      3      0.2693      2694.      CAT(1).TRAP(1).TYPE(3)
[o]      4      0.1303      2694.      CAT(1).TRAP(2).TYPE(1)

```

```

[o]      5      4.521      3810.      CAT(1).TRAP(2).TYPE(2)
[o]      6      0.000      aliased    CAT(1).TRAP(2).TYPE(3)
[o]      7      1.497      1624.      CAT(1).TRAP(3).TYPE(1)
[o]      8      3.040      2199.      CAT(1).TRAP(3).TYPE(2)
[o]      9      0.2895     2036.      CAT(1).TRAP(3).TYPE(3)
[o]     10      26.60      5388.      CAT(2).TRAP(1).TYPE(1)
[o]     11      0.000      aliased    CAT(2).TRAP(1).TYPE(2)
[o]     12      0.000      aliased    CAT(2).TRAP(1).TYPE(3)
[o]     13      2924.      3110.      CAT(2).TRAP(2).TYPE(1)
[o]     14      0.000      aliased    CAT(2).TRAP(2).TYPE(2)
[o]     15      0.000      aliased    CAT(2).TRAP(2).TYPE(3)
[o]     16      0.000      aliased    CAT(2).TRAP(3).TYPE(1)
[o]     17      20661.      3110.      CAT(2).TRAP(3).TYPE(2)
[o]     18      0.000      aliased    CAT(2).TRAP(3).TYPE(3)
[o]      scale parameter taken as 29025542.
[o]
[i] ? !Having a cat, high trapping, and sofa/chair is a significant interact
[i] ? $stab the cta mean for cat;trap;type$
[w] -- the table contains empty cell(s)
[o]
[o]      1      2      3
[o]      1 1      0.0000      0.0000      0.2693
[o]      2      0.1303      4.5210      0.0000
[o]      3      1.4969      3.0401      0.2895
[o]
[o]      2 1      26.5961      0.0000      0.0000
[o]      2      2923.9524      0.0000      0.0000
[o]      3      0.0000      20660.6309      0.0000
[i] ? $stab the csf mean for cat;trap;type$
[w] -- the table contains empty cell(s)
[o]
[o]      1      2      3
[o]      1 1      0.0000      0.0000      1.2972
[o]      2      0.7915      31.5766      0.0000
[o]      3      8.8111      24.6194      2.0453
[o]
[o]      2 1      265.9615      0.0000      0.0000
[o]      2      12249.2578      0.0000      0.0000
[o]      3      0.0000      84680.3984      0.0000
[i] ? $stop$

```

APPENDIX 10

LINEAR REGRESSION/ANCOVA

DER F 1 VS FEL D 1

```

[o] GLIM 3.77 update 1 (copyright)1985 Royal Statistical Society, London
[o]
[i] ? $input 12$
[i] File name? a:vac2.doc
[i] $subfile a:vac2.doc
[i] $units 41$
[i] !This is a data set of all vacuum samples which were collected then
[i] !determined to have sufficient mass to be analyzed by the DACI Lab.
[i] !dtot = the total mass of dust removed from the filter. mngg= mass of
[i] !Der f I mite allergen in nanograms per gram of total dust. cngg= mass
[i] !of Fel d I cat allergen in nanograms per gram of total dust. time=
[i] !sample collection time in minutes. area= the area of surface vacuumed
[i] !in square feet. type= tpe of surface; 1 is carpet 2 is sofa or chair
[i] !3 is mattress or pillow. trap = a number to scale from 1 to 3 to indic
[i] !the thickness/depth combination of the source/surface. no = the sample
[i] $data no dtot mngg cngg time area type trap cat food$
[i] $read
[i] 1 0.328 767 97 8 115.1 3 3 1 1
[i] 2 0.245 1156 57 8 60 1 3 1 1
[i] 3 0.227 118 997 7 19 3 3 1 1
[i] 4 0.227 116 132 7 52.7 1 2 1 1
[i] 5 0.621 60 563 5 37.5 2 2 1 2
[i] 6 0.063 247 25 5 47 1 2 1 2
[i] 7 0.159 25 157 8 37.5 3 3 1 1
[i] 8 0.179 25 557 6 40 1 2 1 1
[i] 9 0.135 54 2323180 6 17.1 2 3 2 3
[i] 10 0.034 70 264397 10 33.8 1 1 2 3
[i] 11 0.696 318 3323 8.5 23.125 2 3 1 4
[i] 12 0.099 222 2281 7.5 14.6 1 3 1 4
[i] 13 0.247 1167 202 7 76.7 3 3 1 1
[i] 14 0.338 168 97 4.5 9.5 3 1 1 1
[i] 15 0.621 175 228 5 12.75 1 3 1 1
[i] 16 0.886 25 25 5 12 1 3 1 4
[i] 17 0.083 25 207 4 8.7 1 3 1 4
[i] 18 0.322 373 25 5 6.4 2 3 1 4
[i] 19 0.087 836 8777972 4 4.3 2 3 2 3
[i] 20 0.024 5718 1830677 5 9.9 1 2 2 3
[i] 21 0.068 301 613 5 13 2 3 1 4
[i] 22 1.302 513 229 7 19.4 1 3 1 4
[i] 23 0.393 208 124 7 12.8 1 3 1 3
[i] 24 0.020 205 25 4.5 20.25 3 1 1 3
[i] 25 0.219 20886 57 8 22.3 1 3 1 3
[i] 26 0.034 3183 25 4 11.9 1 2 1 3
[i] 27 0.038 201 25 4 26.2 3 3 1 1
[i] 28 0.949 62 1350 7.5 23.8 2 2 1 2
[i] 29 0.145 115 25 9 19.0 3 3 1 1
[i] 30 0.148 371 152 7 38.4 3 3 1 1
[i] 32 0.152 59 3134314 4 8.2 2 3 2 3
[i] 33 1.029 25 147843 4 6.0 1 2 2 3
[i] 34 0.372 25 114042 4.5 6.1 1 2 2 3
[i] 35 0.036 548 25 7 6.4 2 3 1 4
[i] 36 0.992 190 305 5 9.0 1 3 1 1
[i] 37 0.040 125 514 6 18.1 3 1 1 1
[i] 39 0.180 976 25 5 7.8 3 1 1 4
[i] 41 0.3138 1233 1051 9 11.3 2 3 1 4
[i] 42 0.2433 1657 461 8 11.7 1 3 1 4
[i] 44 0.4155 292 298 6 8.9 2 3 1 4
[i] 45 1.3827 454 25 6 10.3 1 3 1 4

```

```

[i]
[i] $finish$
[i] ? $calc mtot=mngg*dtot$calc lmt=%log mtot$calc ldt=%log dtot$
[i] ? $calc ctot=cngg*dtot$calc lct=%log ctot$
[i] ? $plot mtot ctot$
[o] 5000.
[o] 4750.
[o] 4500. M
[o] 4250.
[o] 4000.
[o] 3750.
[o] 3500.
[o] 3250.
[o] 3000.
[o] 2750.
[o] 2500.
[o] 2250.
[o] 2000.
[o] 1750.
[o] 1500.
[o] 1250.
[o] 1000.
[o] 750. 2
[o] 500. 2
[o] 250. 6 M
[o] 0. 9M M M M M
-----:-----:-----:-----:-----:-----:
[o] 0. 160000. 320000. 480000. 640000. 800000. 960000
[i] ? $plot lct lmt$
[o] 14.400
[o] 13.600
[o] 12.800 L L
[o] 12.000 L
[o] 11.200
[o] 10.400 L
[o] 9.600
[o] 8.800 L
[o] 8.000
[o] 7.200 L
[o] 6.400
[o] 5.600 L L L L L L
[o] 4.800 L LL L L
[o] 4.000 L L L L L
[o] 3.200 L LL 2 L L L
[o] 2.400 L L L L
[o] 1.600 L L
[o] 0.800 L
[o] 0.000 L L L
[o] -0.800 L
[o] -1.600
-----:-----:-----:-----:-----:-----:
[o] 0.00 1.60 3.20 4.80 6.40 8.00 9.60
[i] ? $yvar lmt$fac type 3$fac trap 3$fac cat 2$fac food 4$error n$link i$
[i] ? $fit %gm$dis e$fit +lct$dis e$fit +cat$dis e$fit +trap$dis e$
[o] deviance = 123.45
[o] d.f. = 40
[o]
[o] estimate s.e. parameter

```

```

[0]      1      3.848      0.2744      1
[0]      scale parameter taken as 3.086
[0]
[0] deviance = 122.97 (change = -0.4764)
[0]      d.f. = 39      (change = -1      )
[0]
[0]      estimate      s.e.      parameter
[0]      1      3.992      0.4614      1
[0]      2      -0.02942      0.07569      LCT
[0]      scale parameter taken as 3.153
[0]
[0] deviance = 103.10 (change = -19.87)
[0]      d.f. = 38      (change = -1      )
[0]
[0]      estimate      s.e.      parameter
[0]      1      3.135      0.5323      1
[0]      2      0.2662      0.1299      LCT
[0]      3      -3.422      1.265      CAT(2)
[0]      scale parameter taken as 2.713
[0]
[0] deviance = 98.143 (change = -4.960)
[0]      d.f. = 36      (change = -2      )
[0]
[0]      estimate      s.e.      parameter
[0]      1      2.504      0.7846      1
[0]      2      0.2010      0.1396      LCT
[0]      3      -2.728      1.368      CAT(2)
[0]      4      0.5516      0.9544      TRAP(2)
[0]      5      1.077      0.8643      TRAP(3)
[0]      scale parameter taken as 2.726
[0]
[i] ? $fit +type$dis e$fit +food$dis e$
[0] deviance = 93.540 (change = -4.603)
[0]      d.f. = 34      (change = -2      )
[0]
[0]      estimate      s.e.      parameter
[0]      1      3.209      1.033      1
[0]      2      0.2080      0.1490      LCT
[0]      3      -2.897      1.395      CAT(2)
[0]      4      -0.01108      1.085      TRAP(2)
[0]      5      0.7750      0.9345      TRAP(3)
[0]      6      -0.5761      0.6745      TYPE(2)
[0]      7      -0.8670      0.7463      TYPE(3)
[0]      scale parameter taken as 2.751
[0]
[0] deviance = 85.107 (change = -8.433)
[0]      d.f. = 31      (change = -3      )
[0]
[0]      estimate      s.e.      parameter
[0]      1      1.770      1.442      1
[0]      2      0.3137      0.1606      LCT
[0]      3      -4.935      1.887      CAT(2)
[0]      4      0.6101      1.246      TRAP(2)
[0]      5      1.067      0.9741      TRAP(3)
[0]      6      -0.6154      0.7745      TYPE(2)
[0]      7      -0.1206      0.9479      TYPE(3)
[0]      8      0.1011      1.474      FOOD(2)
[0]      9      1.870      1.098      FOOD(3)

```

```

[o]      10      0.7694      0.8884      FOOD(4)
[o]      scale parameter taken as  2.745
[o]
[i] ? $fit +food.type$dis e$fit +food.trap$dis e$fit +cat.type$dis e$
[o] deviance = 69.452 (change = -15.65)
[o]      d.f. = 27      (change = -4      )
[o]
[o]      estimate      s.e.      parameter
[o]      1      1.487      1.450      1
[o]      2      0.3518      0.1752      LCT
[o]      3      -5.091      2.073      CAT(2)
[o]      4      0.3216      1.269      TRAP(2)
[o]      5      1.589      1.115      TRAP(3)
[o]      6      0.2535      0.9267      TYPE(2)
[o]      7      -0.4005      1.016      TYPE(3)
[o]      8      0.7759      1.958      FOOD(2)
[o]      9      2.452      1.236      FOOD(3)
[o]     10      -0.2508      1.058      FOOD(4)
[o]     11      -1.281      2.433      TYPE(2).FOOD(2)
[o]     12      -2.474      1.818      TYPE(2).FOOD(3)
[o]     13      0.000      aliased      TYPE(2).FOOD(4)
[o]     14      0.000      aliased      TYPE(3).FOOD(2)
[o]     15      -1.884      2.246      TYPE(3).FOOD(3)
[o]     16      3.803      2.226      TYPE(3).FOOD(4)
[o]      scale parameter taken as  2.572
[o]
[o] deviance = 63.984 (change = -5.468)
[o]      d.f. = 25      (change = -2      )
[o]
[o]      estimate      s.e.      parameter
[o]      1      2.923      1.813      1
[o]      2      0.3267      0.1855      LCT
[o]      3      -4.895      2.788      CAT(2)
[o]      4      -1.845      1.949      TRAP(2)
[o]      5      0.8197      1.284      TRAP(3)
[o]      6      0.2483      0.9245      TYPE(2)
[o]      7      -1.163      1.140      TYPE(3)
[o]      8      1.519      2.067      FOOD(2)
[o]      9      -0.1352      3.182      FOOD(3)
[o]     10      2.917      1.986      FOOD(4)
[o]     11      0.000      aliased      TRAP(2).FOOD(2)
[o]     12      3.795      2.730      TRAP(2).FOOD(3)
[o]     13      0.000      aliased      TRAP(2).FOOD(4)
[o]     14      0.000      aliased      TRAP(3).FOOD(2)
[o]     15      1.761      3.165      TRAP(3).FOOD(3)
[o]     16      -3.728      2.280      TRAP(3).FOOD(4)
[o]     17      -1.124      2.458      TYPE(2).FOOD(2)
[o]     18      -2.177      2.539      TYPE(2).FOOD(3)
[o]     19      0.000      aliased      TYPE(2).FOOD(4)
[o]     20      0.000      aliased      TYPE(3).FOOD(2)
[o]     21      0.01220      3.171      TYPE(3).FOOD(3)
[o]     22      0.000      aliased      TYPE(3).FOOD(4)
[o]      scale parameter taken as  2.559
[o]
[o] deviance = 63.984 (change = 0.)
[o]      d.f. = 25      (change = 0      )
[o]
[o]      estimate      s.e.      parameter

```

[o]	1	2.923	1.813	1
[o]	2	0.3267	0.1855	LCT
[o]	3	-4.895	2.788	CAT(2)
[o]	4	-1.845	1.949	TRAP(2)
[o]	5	0.8197	1.284	TRAP(3)
[o]	6	0.2483	0.9245	TYPE(2)
[o]	7	-1.163	1.140	TYPE(3)
[o]	8	1.519	2.067	FOOD(2)
[o]	9	-0.1352	3.182	FOOD(3)
[o]	10	2.917	1.986	FOOD(4)
[o]	11	-2.177	2.539	CAT(2).TYPE(2)
[o]	12	0.000	aliased	CAT(2).TYPE(3)
[o]	13	0.000	aliased	TRAP(2).FOOD(2)
[o]	14	3.795	2.730	TRAP(2).FOOD(3)
[o]	15	0.000	aliased	TRAP(2).FOOD(4)
[o]	16	0.000	aliased	TRAP(3).FOOD(2)
[o]	17	1.761	3.165	TRAP(3).FOOD(3)
[o]	18	-3.728	2.280	TRAP(3).FOOD(4)
[o]	19	-1.124	2.458	TYPE(2).FOOD(2)
[o]	20	0.000	aliased	TYPE(2).FOOD(3)
[o]	21	0.000	aliased	TYPE(2).FOOD(4)
[o]	22	0.000	aliased	TYPE(3).FOOD(2)
[o]	23	0.01220	3.171	TYPE(3).FOOD(3)
[o]	24	0.000	aliased	TYPE(3).FOOD(4)

scale parameter taken as 2.559

```
[i] ? $fit +trap.type$dis e$
[o] deviance = 63.984 (change = 0.)
[o] d.f. = 25 (change = 0 )
```

	estimate	s.e.	parameter	
[o]	1	2.911	3.150	1
[o]	2	0.3267	0.1855	LCT
[o]	3	-4.895	2.788	CAT(2)
[o]	4	-1.833	3.355	TRAP(2)
[o]	5	0.8319	3.302	TRAP(3)
[o]	6	0.2483	0.9245	TYPE(2)
[o]	7	-1.150	2.933	TYPE(3)
[o]	8	1.519	2.067	FOOD(2)
[o]	9	-0.1230	2.092	FOOD(3)
[o]	10	2.917	1.986	FOOD(4)
[o]	11	-2.177	2.539	CAT(2).TYPE(2)
[o]	12	0.000	aliased	CAT(2).TYPE(3)
[o]	13	-1.124	2.458	TRAP(2).TYPE(2)
[o]	14	0.000	aliased	TRAP(2).TYPE(3)
[o]	15	0.000	aliased	TRAP(3).TYPE(2)
[o]	16	-0.01220	3.171	TRAP(3).TYPE(3)
[o]	17	0.000	aliased	TRAP(2).FOOD(2)
[o]	18	3.783	2.771	TRAP(2).FOOD(3)
[o]	19	0.000	aliased	TRAP(2).FOOD(4)
[o]	20	0.000	aliased	TRAP(3).FOOD(2)
[o]	21	1.749	2.495	TRAP(3).FOOD(3)
[o]	22	-3.728	2.280	TRAP(3).FOOD(4)
[o]	23	0.000	aliased	TYPE(2).FOOD(2)
[o]	24	0.000	aliased	TYPE(2).FOOD(3)
[o]	25	0.000	aliased	TYPE(2).FOOD(4)
[o]	26	0.000	aliased	TYPE(3).FOOD(2)
[o]	27	0.000	aliased	TYPE(3).FOOD(3)

```

[o]      28      0.000      aliased      TYPE(3).FOOD(4)
[o]      scale parameter taken as  2.559
[o]
[i] ? $fit +cat.trap$dis e$
[o] deviance = 63.984 (change =  0.)
[o]    d.f. = 25      (change =  0 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      2.923      1.813      1
[o]      2      0.3267      0.1855      LCT
[o]      3      -4.907      2.948      CAT(2)
[o]      4      -1.845      1.949      TRAP(2)
[o]      5      0.8197      1.284      TRAP(3)
[o]      6      0.2483      0.9245      TYPE(2)
[o]      7      -1.163      1.140      TYPE(3)
[o]      8      1.519      2.067      FOOD(2)
[o]      9      -0.1230      2.092      FOOD(3)
[o]     10      2.917      1.986      FOOD(4)
[o]     11      0.01220      3.171      CAT(2).TRAP(2)
[o]     12      -2.165      3.072      CAT(2).TRAP(3)
[o]     13      0.000      aliased      CAT(2).TYPE(2)
[o]     14      0.000      aliased      CAT(2).TYPE(3)
[o]     15      -1.124      2.458      TRAP(2).TYPE(2)
[o]     16      0.000      aliased      TRAP(2).TYPE(3)
[o]     17      0.000      aliased      TRAP(3).TYPE(2)
[o]     18      0.000      aliased      TRAP(3).TYPE(3)
[o]     19      0.000      aliased      TRAP(2).FOOD(2)
[o]     20      3.783      2.771      TRAP(2).FOOD(3)
[o]     21      0.000      aliased      TRAP(2).FOOD(4)
[o]     22      0.000      aliased      TRAP(3).FOOD(2)
[o]     23      1.749      2.495      TRAP(3).FOOD(3)
[o]     24      -3.728      2.280      TRAP(3).FOOD(4)
[o]     25      0.000      aliased      TYPE(2).FOOD(2)
[o]     26      0.000      aliased      TYPE(2).FOOD(3)
[o]     27      0.000      aliased      TYPE(2).FOOD(4)
[o]     28      0.000      aliased      TYPE(3).FOOD(2)
[o]     29      0.000      aliased      TYPE(3).FOOD(3)
[o]     30      0.000      aliased      TYPE(3).FOOD(4)
[o]      scale parameter taken as  2.559
[o]
[i] ? $stop$

```

APPENDIX 11

LINEAR REGRESSION/ANCOVA

DER F 1 UNITS OF CONCENTRATION

```

[o] GLIM 3.77 update 1 (copyright)1985 Royal Statistical Society, London
[o]
[i] ? $input 12$
[i] File name? a:vacmite.doc
[i] $subfile a:vac2.doc
[i] $units 35$
[i] !This is a data set of all vacuum samples with detectable Der f 1.
[i] !
[i] !dtot = the total mass of dust removed from the filter. mngg= mass of
[i] !Der f I mite allergen in nanograms per gram of total dust. cngg= mass
[i] !of Fel d I cat allergen in nanograms per gram of total dust. time=
[i] !sample collection time in minutes. area= the area of surface vacuumed
[i] !in square feet. type= tpe of surface; 1 is carpet 2 is sofa or chair
[i] !3 is mattress or pillow. trap = a number to scale from 1 to 3 to indic
[i] !the thickness/depth combination of the source/surface. no = the sample
[i] $data no dtot mngg cngg time area type trap cat food$
[i] $read
[i] 1 0.328 767 97 8 115.1 3 3 1 1
[i] 2 0.245 1156 57 8 60 1 3 1 1
[i] 3 0.227 118 997 7 19 3 3 1 1
[i] 4 0.227 116 132 7 52.7 1 2 1 1
[i] 5 0.621 60 563 5 37.5 2 2 1 2
[i] 6 0.063 247 25 5 47 1 2 1 2
[i]
[i]
[i] 9 0.135 54 2323180 6 17.1 2 3 2 3
[i] 10 0.034 70 264397 10 33.8 1 1 2 3
[i] 11 0.696 318 3323 8.5 23.125 2 3 1 4
[i] 12 0.099 222 2281 7.5 14.6 1 3 1 4
[i] 13 0.247 1167 202 7 76.7 3 3 1 1
[i] 14 0.338 168 97 4.5 9.5 3 1 1 1
[i] 15 0.621 175 228 5 12.75 1 3 1 1
[i]
[i]
[i] 18 0.322 373 25 5 6.4 2 3 1 4
[i] 19 0.087 836 8777972 4 4.3 2 3 2 3
[i] 20 0.024 5718 1830677 5 9.9 1 2 2 3
[i] 21 0.068 301 613 5 13 2 3 1 4
[i] 22 1.302 513 229 7 19.4 1 3 1 4
[i] 23 0.393 208 124 7 12.8 1 3 1 3
[i] 24 0.020 205 25 4.5 20.25 3 1 1 3
[i] 25 0.219 20886 57 8 22.3 1 3 1 3
[i] 26 0.034 3183 25 4 11.9 1 2 1 3
[i] 27 0.038 201 25 4 26.2 3 3 1 1
[i] 28 0.949 62 1350 7.5 23.8 2 2 1 2
[i] 29 0.145 115 25 9 19.0 3 3 1 1
[i] 30 0.148 371 152 7 38.4 3 3 1 1
[i] 32 0.152 59 3134314 4 8.2 2 3 2 3
[i]
[i]
[i] 35 0.036 548 25 7 6.4 2 3 1 4
[i] 36 0.992 190 305 5 9.0 1 3 1 1
[i] 37 0.040 125 514 6 18.1 3 1 1 1
[i] 39 0.180 976 25 5 7.8 3 1 1 4
[i] 41 0.3138 1233 1051 9 11.3 2 3 1 4
[i] 42 0.2433 1657 461 8 11.7 1 3 1 4
[i] 44 0.4155 292 298 6 8.9 2 3 1 4
[i] 45 1.3827 454 25 6 10.3 1 3 1 4

```

```

[i]
[i] $finish$
[i] ? $calc mtot=mngg*dtot$calc msf=mtot/area$calc ta=time*area$
[i] ? $calc mta=mtot/ta$calc lmngg=%log mngg$calc lmsf=%log msf$
[i] ? $calc lmta=%log mta$calc ldtot=%log dtot$
[i] ? $plot mtot dtot$
[o] 5000.
[o] 4750.
[o] 4500. M
[o] 4250.
[o] 4000.
[o] 3750.
[o] 3500.
[o] 3250.
[o] 3000.
[o] 2750.
[o] 2500.
[o] 2250.
[o] 2000.
[o] 1750.
[o] 1500.
[o] 1250.
[o] 1000.
[o] 750. M M
[o] 500. M M
[o] 250. M M 2 M M M
[o] 0. 622 4 2 2 MM 2 M
[o] -----:-----:-----:-----:-----:-----:-----:
[o] 0.000 0.300 0.600 0.900 1.200 1.500 1.800
[i] ? !This is a plot of total Der f 1 compared to total sieved dust from th
[i] ? !same filter.
[i] ? $plot mngg msf$
[o] 24000.
[o] 22800.
[o] 21600.
[o] 20400. M
[o] 19200.
[o] 18000.
[o] 16800.
[o] 15600.
[o] 14400.
[o] 13200.
[o] 12000.
[o] 10800.
[o] 9600.
[o] 8400.
[o] 7200.
[o] 6000. M
[o] 4800.
[o] 3600. M
[o] 2400.
[o] 1200. M2 M M 2
[o] 0. 932M2 M M
[o] -----:-----:-----:-----:-----:-----:-----:
[o] 0.0 50.0 100.0 150.0 200.0 250.0 300.0
[i] ? !This is a plot of Der f 1 in ng/g vs ng/sf.
[i] ?
[i] ? $Plot lmngg lmsf$

```



```

[0]      8.100      |
[0]      7.800      |
[0]      7.500      |
[0]      7.200      |
[0]      6.900      |
[0]      6.600      |
[0]      6.300      |
[0]      6.000      |
[0]      5.700      |
[0]      5.400      |
[0]      5.100      |
[0]      4.800      |
[0]      4.500      |
[0]      4.200      |
[0]      3.900      |
[0] -----:-----:-----:-----:-----:-----:-----:
[0]      -6.00      -4.00      -2.00      0.00      2.00      4.00      6.00
[i] ? !This is a plot of the lns of Der f l in ng/g vs ng/sf*min.
[i] ?
[i] ? $yvar lmta$error n$link i$fac type 3$fac food 4$fac trap 3$fac cat 2$f
[0] deviance = 118.66
[0] d.f. = 34
[0]
[i] ? $dis e$fit +lmngg$dis e$
[0]      estimate      s.e.      parameter
[0]      1      -0.5189      0.3158      1
[0]      scale parameter taken as 3.490
[0]
[0] deviance = 66.026 (change = -52.64)
[0] d.f. = 33 (change = -1 )
[0]
[0]      estimate      s.e.      parameter
[0]      1      -5.930      1.082      1
[0]      2      0.9226      0.1799      LMNG
[0]      scale parameter taken as 2.001
[0]
[i] ? !R = 0.666. p<0.05. The y intercept is not zero.
[i] ? $scal res=lmta-%fv$scal sre=res/%sqrt(%sc)$hist sre$
[0] [-3.0,-2.0) 1 S
[0] [-2.0,-1.0) 5 SSSSS
[0] [-1.0, 0.0) 13 SSSSSSSSSSSSSS
[0] [ 0.0, 1.0) 9 SSSSSSSSS
[0] [ 1.0, 2.0] 7 SSSSSSS
[i] ? !The residuals are fairly bell shaped.
[i] ? !If the grand mean is subtracted to force through zero:
[i] ? $fit -%gm$dis e$
[0] deviance = 126.15 (change = +60.13)
[0] d.f. = 34 (change = +1 )
[0]
[0]      estimate      s.e.      parameter
[0]      1      -0.03909      0.05415      LMNG
[0]      scale parameter taken as 3.710
[0]
[i] ? !The slope is no longer significant if forced through zero.
[i] ? !If not forced through zero, the Der f l in ng/g is loosely correlated
[i] ? !with ng/sf*min, with r=0.67, but it is statistically significant at p
[i] ? $fit +food$dis e$fit +trap$dis e$fit +type$dis e$fit +cat$dis e$
[0] deviance = 55.076 (change = -71.08)

```

```

[o]      d.f. = 30      (change =  -4      )
[o]
[o]      estimate      s.e.      parameter
[o]      1      0.8589      0.1865      LMNG
[o]      2      -5.939      1.107      FOOD(1)
[o]      3      -5.745      1.158      FOOD(2)
[o]      4      -5.998      1.252      FOOD(3)
[o]      5      -4.726      1.232      FOOD(4)
[o]      scale parameter taken as 1.836
[o]
[o] deviance = 50.839 (change = -4.237)
[o]      d.f. = 28      (change = -2      )
[o]
[o]      estimate      s.e.      parameter
[o]      1      0.8445      0.1978      LMNG
[o]      2      -6.590      1.183      FOOD(1)
[o]      3      -5.887      1.373      FOOD(2)
[o]      4      -6.483      1.286      FOOD(3)
[o]      5      -5.502      1.336      FOOD(4)
[o]      6      0.2083      1.063      TRAP(2)
[o]      7      0.9522      0.6878      TRAP(3)
[o]      scale parameter taken as 1.816
[o]
[o] deviance = 46.760 (change = -4.078)
[o]      d.f. = 26      (change = -2      )
[o]
[o]      estimate      s.e.      parameter
[o]      1      0.9406      0.2173      LMNG
[o]      2      -5.713      1.394      FOOD(1)
[o]      3      -5.512      1.611      FOOD(2)
[o]      4      -6.409      1.418      FOOD(3)
[o]      5      -5.471      1.492      FOOD(4)
[o]      6      -0.8205      1.262      TRAP(2)
[o]      7      0.1791      0.8637      TRAP(3)
[o]      8      0.3213      0.6700      TYPE(2)
[o]      9      -1.117      0.7898      TYPE(3)
[o]      scale parameter taken as 1.798
[o]
[o] deviance = 46.040 (change = -0.7206)
[o]      d.f. = 25      (change = -1      )
[o]
[o]      estimate      s.e.      parameter
[o]      1      0.9109      0.2249      LMNG
[o]      2      -5.468      1.464      FOOD(1)
[o]      3      -5.451      1.633      FOOD(2)
[o]      4      -5.875      1.670      FOOD(3)
[o]      5      -5.312      1.531      FOOD(4)
[o]      6      -0.8314      1.277      TRAP(2)
[o]      7      0.1377      0.8765      TRAP(3)
[o]      8      0.4496      0.7083      TYPE(2)
[o]      9      -1.190      0.8076      TYPE(3)
[o]      10     -0.6437      1.029      CAT(2)
[o]      scale parameter taken as 1.842
[o]
[i] ? !Putting in the factors of food, trapping, and type make the slope
[i] ? !statistically significant again, with the grand mean subtracted out.
[i] ?
[i] ? $Yvar lmsf$error n$link i$fac type 3$fac food 4$fac trap 3$

```

[w] -- model changed

```
[i] ? $fit %gm$dis e$fit +lmngg$dis e$
[o] deviance = 117.48
[o] d.f. = 34
[o]
[o] estimate      s.e.      parameter
[o] 1      1.293      0.3142      1
[o] scale parameter taken as 3.455
[o]
[o] deviance = 63.333 (change = -54.15)
[o] d.f. = 33      (change = -1 )
[o]
[o] estimate      s.e.      parameter
[o] 1      -4.196      1.059      1
[o] 2      0.9358      0.1762      LMNG
[o] scale parameter taken as 1.919
[o]
[i] ? !There is a statistically significant correlation between the ln of De
[i] ? !in ng/g and ng/sf with R=0.679. There is a y intercept, however.
[i] ? $scal res=lmngg-%fv$scal sre=res/%sqrt(%sc)$hist sre$
[o] [3.2,3.3) 11 SSSSSSSSSSS
[o] [3.3,3.3) 14 SSSSSSSSSSSSSS
[o] [3.3,3.4) 7 SSSSSSS
[o] [3.4,3.5) 2 SS
[o] [3.5,3.5) 1 S
[i] ? !Residuals are a little skewed.
[i] ? $fit -%gm$dis e$fit +food$dis e$fit +trap$dis e$fit +type$dis e$
[o] deviance = 93.435 (change = +30.10)
[o] d.f. = 34      (change = +1 )
[o]
[o] estimate      s.e.      parameter
[o] 1      0.2554      0.04660      LMNG
[o] scale parameter taken as 2.748
[o]
[o] deviance = 50.323 (change = -43.11)
[o] d.f. = 30      (change = -4 )
[o]
[o] estimate      s.e.      parameter
[o] 1      0.8726      0.1783      LMNG
[o] 2      -4.178      1.058      FOOD(1)
[o] 3      -4.063      1.107      FOOD(2)
[o] 4      -4.373      1.197      FOOD(3)
[o] 5      -2.926      1.178      FOOD(4)
[o] scale parameter taken as 1.677
[o]
[o] deviance = 45.050 (change = -5.273)
[o] d.f. = 28      (change = -2 )
[o]
[o] estimate      s.e.      parameter
[o] 1      0.8644      0.1862      LMNG
[o] 2      -4.911      1.113      FOOD(1)
[o] 3      -4.134      1.293      FOOD(2)
```

```

[o]      4      -4.916      1.210      FOOD(3)
[o]      5      -3.808      1.258      FOOD(4)
[o]      6      0.1087      1.000      TRAP(2)
[o]      7      1.026      0.6474      TRAP(3)
[o]      scale parameter taken as 1.609
[o]
[o] deviance = 40.408 (change = -4.642)
[o]      d.f. = 26      (change = -2      )
[o]
[o]      estimate      s.e.      parameter
[o]      1      0.9497      0.2020      LMNG
[o]      2      -3.873      1.295      FOOD(1)
[o]      3      -3.541      1.497      FOOD(2)
[o]      4      -4.691      1.319      FOOD(3)
[o]      5      -3.612      1.387      FOOD(4)
[o]      6      -0.9981      1.173      TRAP(2)
[o]      7      0.2390      0.8029      TRAP(3)
[o]      8      0.1848      0.6228      TYPE(2)
[o]      9      -1.244      0.7342      TYPE(3)
[o]      scale parameter taken as 1.554
[o]
[i] ? $calc res=lmngg-%fv$calc sre=res/%sqrt(%sc)$hist sre$
[o] [2.5,3.0) 9 SSSSSSSSS
[o] [3.0,3.5) 4 SSSS
[o] [3.5,4.0) 9 SSSSSSSSS
[o] [4.0,4.5) 10 SSSSSSSSSS
[o] [4.5,5.0] 3 SSS
[i] ? !Bimodal??? This is with food and trapping and type furniture added as
[i] ? !ficant.
[i] ?
[i] ?
[i] ?
[i] ?
[i] ?
[i] ?
[i] ?
[i] ?
[i] ?
[i] ? $stop$

```

APPENDIX 12

LINEAR REGRESSION/ANCOVA

FEL D 1 UNITS OF CONCENTRATION

```

[O] GLIM 3.77 update 1 (copyright)1985 Royal Statistical Society, London
[O]
[i] ? $input 12$
[i] File name? a:vaccat.doc
[i] $subfile a:vac2.doc
[i] $units 32$
[i] !This is a data set of all vacuum samples which had detectable Fel d 1.
[i] !
[i] !dtot = the total mass of dust removed from the filter. mngg= mass of
[i] !Der f I mite allergen in nanograms per gram of total dust. cngg= mass
[i] !of Fel d I cat allergen in nanograms per gram of total dust. time=
[i] !sample collection time in minutes. area= the area of surface vacuumed
[i] !in square feet. type= tpe of surface; 1 is carpet 2 is sofa or chair
[i] !3 is mattress or pillow. trap = a number to scale from 1 to 3 to indic
[i] !the thickness/depth combination of the source/surface. no = the sample
[i] $data no dtot mngg cngg time area type trap cat food$
[i] $read
[i] 1 0.328 767 97 8 115.1 3 3 1 1
[i] 2 0.245 1156 57 8 60 1 3 1 1
[i] 3 0.227 118 997 7 19 3 3 1 1
[i] 4 0.227 116 132 7 52.7 1 2 1 1
[i] 5 0.621 60 563 5 37.5 2 2 1 2
[i] 6 0.063 247 25 5 47 1 2 1 2
[i] 7 0.159 25 157 8 37.5 3 3 1 1
[i] 8 0.179 25 557 6 40 1 2 1 1
[i] 9 0.135 54 2323180 6 17.1 2 3 2 3
[i] 10 0.034 70 264397 10 33.8 1 1 2 3
[i] 11 0.696 318 3323 8.5 23.125 2 3 1 4
[i] 12 0.099 222 2281 7.5 14.6 1 3 1 4
[i] 13 0.247 1167 202 7 76.7 3 3 1 1
[i] 14 0.338 168 97 4.5 9.5 3 1 1 1
[i] 15 0.621 175 228 5 12.75 1 3 1 1
[i]
[i] 17 0.083 25 207 4 8.7 1 3 1 4
[i]
[i] 19 0.087 836 8777972 4 4.3 2 3 2 3
[i] 20 0.024 5718 1830677 5 9.9 1 2 2 3
[i] 21 0.068 301 613 5 13 2 3 1 4
[i] 22 1.302 513 229 7 19.4 1 3 1 4
[i] 23 0.393 208 124 7 12.8 1 3 1 3
[i]
[i] 25 0.219 20886 57 8 22.3 1 3 1 3
[i]
[i]
[i] 28 0.949 62 1350 7.5 23.8 2 2 1 2
[i]
[i]
[i] 30 0.148 371 152 7 38.4 3 3 1 1
[i] 32 0.152 59 3134314 4 8.2 2 3 2 3
[i] 33 1.029 25 147843 4 6.0 1 2 2 3
[i] 34 0.372 25 114042 4.5 6.1 1 2 2 3
[i]
[i] 36 0.992 190 305 5 9.0 1 3 1 1
[i] 37 0.040 125 514 6 18.1 3 1 1 1
[i]
[i] 41 0.3138 1233 1051 9 11.3 2 3 1 4
[i] 42 0.2433 1657 461 8 11.7 1 3 1 4
[i] 44 0.4155 292 298 6 8.9 2 3 1 4
[i]

```

```

[i]
[i] $finish$
[i] ? $calc ctot=cngg*dtot$calc ta=time*area$calc cta=ctot/ta$
[i] ? $calc csf=ctot/area$calc lcnng=%log cngg$calc lcta=%log cta$
[i] ? $calc lcsf=%log csf$calc ldtot=%log dtot$
[i] ? $plot ctot dtot$
[o] 800000.
[o] 760000. C
[o] 720000.
[o] 680000.
[o] 640000.
[o] 600000.
[o] 560000.
[o] 520000.
[o] 480000. C
[o] 440000.
[o] 400000.
[o] 360000.
[o] 320000. C
[o] 280000.
[o] 240000.
[o] 200000.
[o] 160000. C
[o] 120000.
[o] 80000.
[o] 40000. C
[o] 0. C 222 2CC5 C2 CC 2 C CC C
[o] -----:-----:-----:-----:-----:-----:-----:
[o] 0.000 0.300 0.600 0.900 1.200 1.500 1.800
[i] ? !This is a plot of total Fel d 1 vs total sieved dust off filter.
[i] ?
[i] ? $plot lcnng ldtot$
[o] 16.000 L
[o] 15.200 L
[o] 14.400 L
[o] 13.600 L
[o] 12.800 L
[o] 12.000 L
[o] 11.200 L
[o] 10.400 L
[o] 9.600
[o] 8.800
[o] 8.000 L
[o] 7.200 L
[o] 6.400 L L L L L L L L
[o] 5.600 L L L L L L L L L
[o] 4.800 LL L 2 L
[o] 4.000 LL
[o] 3.200 L
[o] 2.400
[o] 1.600
[o] 0.800
[o] 0.000
[o] -----:-----:-----:-----:-----:-----:-----:
[o] -4.000 -3.200 -2.400 -1.600 -0.800 0.000 0.800
[i] ? !This is a plot of the ln of Fel d 1 vs ln total sieved dust off filte
[i] ?
[i] ? $Plot cngg csf$

```

```

[o] 1.00e+07
[o] 9.50e+06
[o] 9.00e+06
[o] 8.50e+06
[o] 8.00e+06
[o] 7.50e+06
[o] 7.00e+06
[o] 6.50e+06
[o] 6.00e+06
[o] 5.50e+06
[o] 5.00e+06
[o] 4.50e+06
[o] 4.00e+06
[o] 3.50e+06
[o] 3.00e+06
[o] 2.50e+06
[o] 2.00e+06
[o] 1.50e+06
[o] 1.00e+06
[o] 5.00e+05
[o] 0.00e+00

```

```

-----:-----:-----:-----:-----:-----:-----:
[o] 0. 40000. 80000. 120000. 160000. 200000. 240000
[i] ? !This is Fel d 1 in ng/g vs ng/sf.
[i] ?
[i] ? $plot lcnng lcsf$
[o] 16.000
[o] 15.200
[o] 14.400
[o] 13.600
[o] 12.800
[o] 12.000
[o] 11.200
[o] 10.400
[o] 9.600
[o] 8.800
[o] 8.000
[o] 7.200
[o] 6.400
[o] 5.600
[o] 4.800
[o] 4.000
[o] 3.200
[o] 2.400
[o] 1.600
[o] 0.800
[o] 0.000

```

```

-----:-----:-----:-----:-----:-----:-----:
[o] -4.00 0.00 4.00 8.00 12.00 16.00 20.00
[i] ? !This is a plot of the Fel d 1 ln of ng/g vs ln of ng/sf.
[i] ?
[i] ? $yvar lcnng$fac cat 2$fac type 3$fac trap 3$error n$link i$fit %gm$dis
[o] deviance = 406.51
[o] d.f. = 31
[o]
[o] estimate s.e. parameter
[o] 1 7.424 0.6401 1
[o] scale parameter taken as 13.11

```

```

[o]
[i] ? $fit +lcsf$dis e$
[o] deviance = 44.965 (change = -361.5)
[o] d.f. = 30 (change = -1 )
[o]
[o] estimate s.e. parameter
[o] 1 4.851 0.2726 1
[o] 2 0.8614 0.05546 LCSF
[o] scale parameter taken as 1.499
[o]
[i] ? !Slope is significant p,0.05 for ln of ng/g vs ln of ng/sf. R= 0.943.
[i] ? !These two measurements are highly correlated. There is a y-intercept
[i] ? !If subtract the grand mean and add factors:
[i] ? $fit +cat$dis e$
[o] deviance = 23.077 (change = -21.89)
[o] d.f. = 29 (change = -1 )
[o]
[o] estimate s.e. parameter
[o] 1 5.081 0.2034 1
[o] 2 0.4868 0.08205 LCSF
[o] 3 4.062 0.7746 CAT(2)
[o] scale parameter taken as 0.7958
[o]
[i] ? !Slope is still significant when accounting for presence or absence of
[i] ? $fit -%gm$dis e$
[o] deviance = 23.077 (change = 0.)
[o] d.f. = 29 (change = 0 )
[o]
[o] estimate s.e. parameter
[o] 1 0.4868 0.08205 LCSF
[o] 2 5.081 0.2034 CAT(1)
[o] 3 9.143 0.8422 CAT(2)
[o] scale parameter taken as 0.7958
[o]
[i] ? !Still significant if grand mean removed.
[i] ? $calc res=lcngg-%fv$calc sre=res/%sqrt(%sc)$hist sre$
[o] [-3.0,-2.0) 2 SS
[o] [-2.0,-1.0) 4 SSSS
[o] [-1.0, 0.0) 7 SSSSSSS
[o] [ 0.0, 1.0) 15 SSSSSSSSSSSSSSS
[o] [ 1.0, 2.0) 4 SSSS
[i] ? !residuals are somewhat bell-shaped.
[i] ? $fit +trap$dis e$fit +type$dis e$fit +type.trap$dis e$
[o] deviance = 22.474 (change = -0.6036)
[o] d.f. = 27 (change = -2 )
[o]
[o] estimate s.e. parameter
[o] 1 0.4832 0.08914 LCSF
[o] 2 5.264 0.5457 CAT(1)
[o] 3 9.416 0.9281 CAT(2)
[o] 4 -0.4249 0.6263 TRAP(2)
[o] 5 -0.1303 0.5978 TRAP(3)
[o] scale parameter taken as 0.8324
[o]
[o] deviance = 18.674 (change = -3.800)
[o] d.f. = 25 (change = -2 )
[o]
[o] estimate s.e. parameter

```

```

[o]      1      0.3864      0.1008      LCSF
[o]      2      4.989      0.6110      CAT(1)
[o]      3      9.847      1.010      CAT(2)
[o]      4      -0.2782      0.6491      TRAP(2)
[o]      5      -0.09371      0.5902      TRAP(3)
[o]      6      0.9347      0.4269      TYPE(2)
[o]      7      0.3965      0.4481      TYPE(3)

```

```

[o]      scale parameter taken as 0.7470

```

```

[o]      deviance = 17.927 (change = -0.7474)

```

```

[o]      d.f. = 23      (change = -2      )

```

```

[o]      estimate      s.e.      parameter
[o]      1      0.4414      0.1174      LCSF
[o]      2      5.851      1.088      CAT(1)
[o]      3      10.02      1.100      CAT(2)
[o]      4      -0.9943      1.045      TRAP(2)
[o]      5      -1.110      1.202      TRAP(3)
[o]      6      1.054      0.5063      TYPE(2)
[o]      7      -0.7442      1.282      TYPE(3)
[o]      8      -0.5129      1.008      TRAP(2).TYPE(2)
[o]      9      0.000      aliased      TRAP(2).TYPE(3)
[o]     10      0.000      aliased      TRAP(3).TYPE(2)
[o]     11      1.392      1.448      TRAP(3).TYPE(3)

```

```

[o]      scale parameter taken as 0.7794

```

```

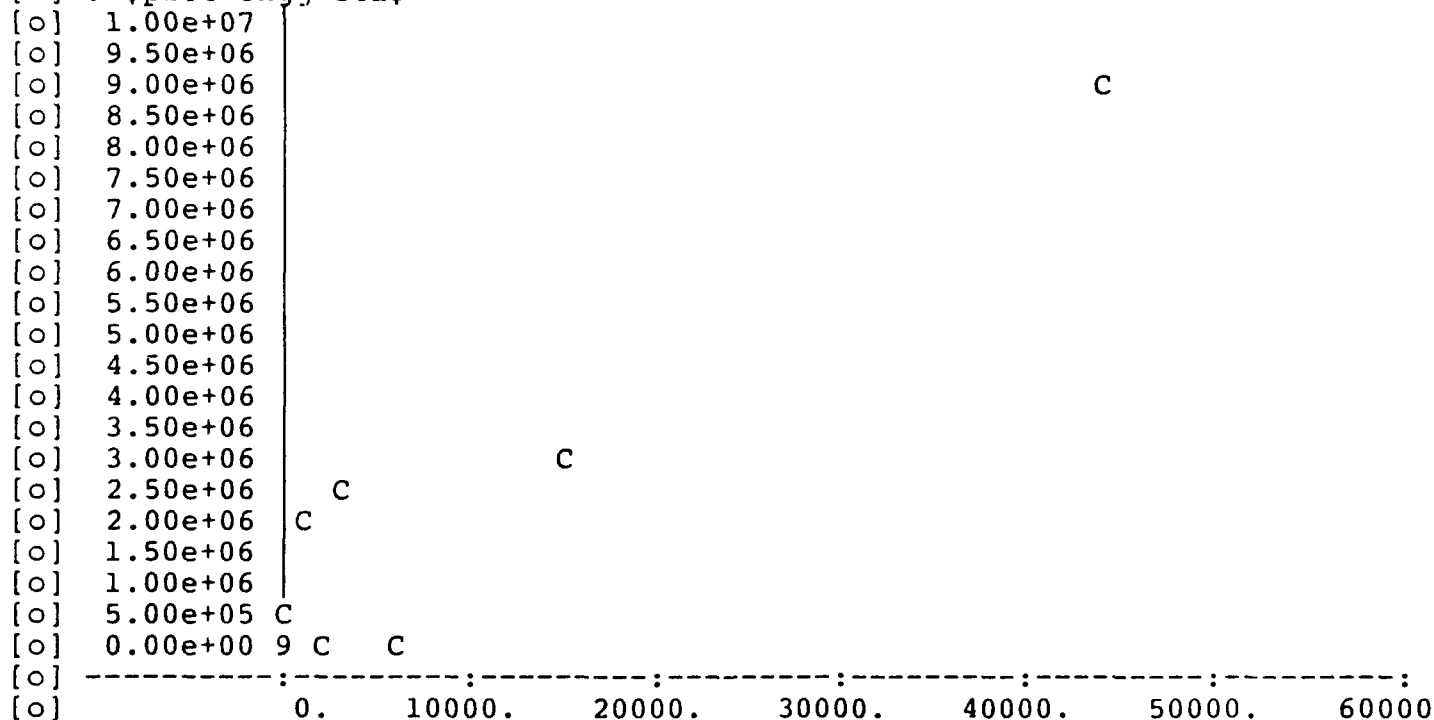
[i] ? !Still significant slope, but the only factor that matters is cat pres
[i] ?

```

```

[i] ? $plot cngg cta$

```



```

[i] ? !Fel d 1 in ng/g vs ng/sf*min.

```

```

[i] ?

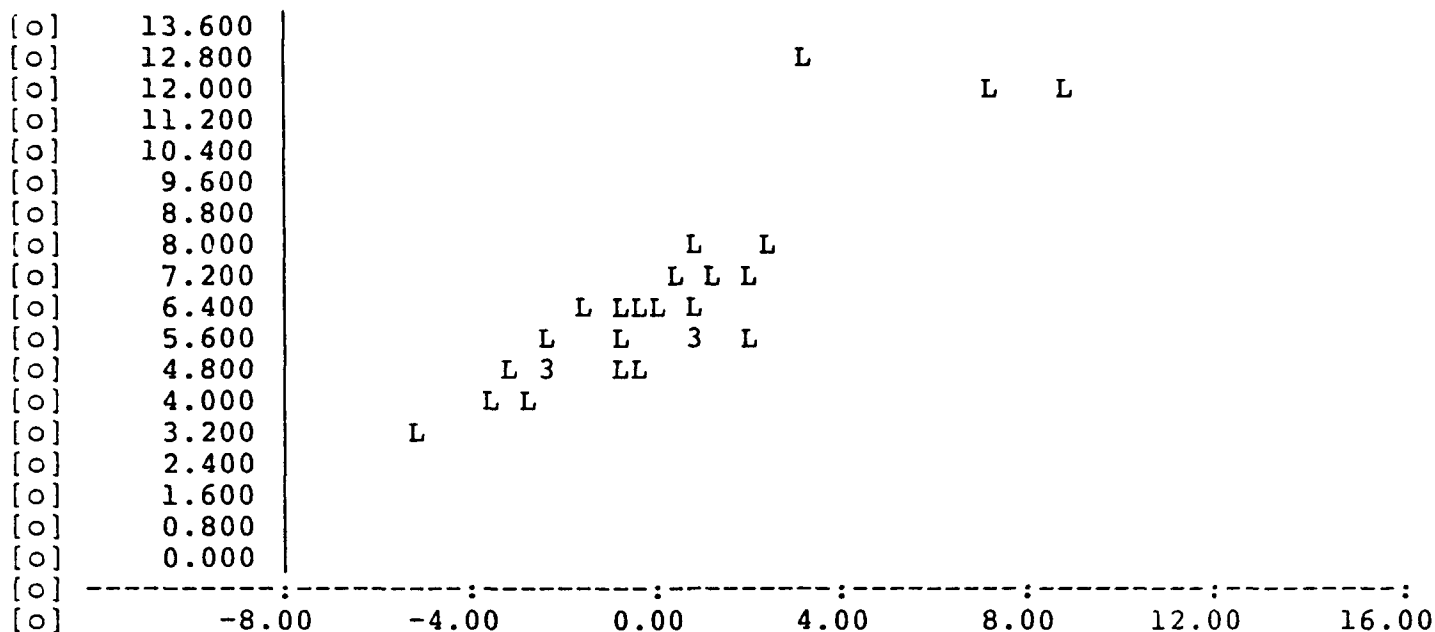
```

```

[i] ? $plot lcngg lcta$

```





```
[i] ?
[i] ? !Ln of ng/g vs ln of ng/sf*min, Fel d 1.
[i] ?
[i] ? $yvar lcta$fac cat 2$fac trap 3$fac type 3$error n$link i$fit %gm$dis
[w] -- model changed
[o] deviance = 517.34
[o] d.f. = 31
[o]
[o] estimate      s.e.      parameter
[o] 1      1.172      0.7222      1
[o] scale parameter taken as 16.69
[o]
[i] ? $fit +lcngg$dis e$scal res=lcngg-%fv$scal sre=res/%sqrt(%sc)$hist sre$
[o] deviance = 62.233 (change = -455.1)
[o] d.f. = 30 (change = -1 )
[o]
[o] estimate      s.e.      parameter
[o] 1      -6.684      0.5883      1
[o] 2      1.058      0.07144      LCNG
[o] scale parameter taken as 2.074
[o]
[o] [4.0,4.1) 4 SSSS
[o] [4.1,4.2) 3 SSS
[o] [4.2,4.3) 1 S
[o] [4.3,4.4) 17 SSSSSSSSSSSSSSSSSSS
[o] [4.4,4.6] 7 SSSSSSS
[i] ? !Slope is significant p<<0.05. R = 0.938.
[i] ? !These two measures are highly correlated - ng/g vs ng/sf*min.
[i] ? !Residual is sort of bimodal.
[i] ? !There is a y-intercept.
[i] ? $fit +cat$dis e$
[o] deviance = 62.030 (change = -0.2023)
```

```

[o]      d.f. = 29      (change = -1      )
[o]
[o]      estimate      s.e.      parameter
[o]      1      -7.002      1.195      1
[o]      2      1.117      0.2046      LCNG
[o]      3      -0.5426      1.764      CAT(2)
[o]      scale parameter taken as 2.139
[o]
[i] ? $calc res=lcngg-%fv$calc sre=res/%sqrt(%sc)$hist sre$
[o] [3.8,4.0) 3 SSS
[o] [4.0,4.1) 2 SS
[o] [4.1,4.3) 12 SSSSSSSSSSSS
[o] [4.3,4.4) 12 SSSSSSSSSSSS
[o] [4.4,4.6] 3 SSS
[i] ? $fit -%gm$dis e$fit +trap$dis e$fit +type$dis e$
[o] deviance = 62.030 (change = 0.)
[o]      d.f. = 29      (change = 0 )
[o]
[o]      estimate      s.e.      parameter
[o]      1      1.117      0.2046      LCNG
[o]      2      -7.002      1.195      CAT(1)
[o]      3      -7.545      2.862      CAT(2)
[o]      scale parameter taken as 2.139
[o]
[o] deviance = 58.324 (change = -3.707)
[o]      d.f. = 27      (change = -2      )
[o]
[o]      estimate      s.e.      parameter
[o]      1      1.076      0.2146      LCNG
[o]      2      -7.861      1.386      CAT(1)
[o]      3      -7.997      3.007      CAT(2)
[o]      4      1.181      0.9958      TRAP(2)
[o]      5      1.188      0.9346      TRAP(3)
[o]      scale parameter taken as 2.160
[o]
[o] deviance = 54.356 (change = -3.967)
[o]      d.f. = 25      (change = -2      )
[o]
[o]      estimate      s.e.      parameter
[o]      1      0.9436      0.2708      LCNG
[o]      2      -6.580      1.717      CAT(1)
[o]      3      -5.944      3.654      CAT(2)
[o]      4      0.5789      1.108      TRAP(2)
[o]      5      0.7512      0.9959      TRAP(3)
[o]      6      0.4871      0.7897      TYPE(2)
[o]      7      -0.7660      0.7573      TYPE(3)
[o]      scale parameter taken as 2.174
[o]
[i] ? !Slope is still significant when grand mean is subtracted. Presence of
[i] ? !cat is important.
[i] ? $stop$

```

APPENDIX 13

LINEAR REGRESSION/ANCOVA

FEL D 1 AIR VS SURFACE SAMPLES

```

[O] GLIM 3.77 update 1 (copyright)1985 Royal Statistical Society, London
[O]
[i] ? $input 12$
[i] File name? a:vac4.doc
[i] $subfile vac3.doc
[i] !
[i] $echo$
[i] $units 7$
[i] $data Ano   cat   cconc   vol   act   vno   mngg   cngg   area   time   dtot
[i] $read
[i]      614 2 0.101 21682.5   2   30   371   152   38.4   7   0.148
[i]
[i]
[i]
[i]
[i]
[i]      619 2      0.04   21254.75  1  9 54 2323180 17.1   6      0.1
[i]
[i]
[i]      613 2      61.441   472      4      9      54 2323180 17.1   6   0.1
[i]      612 1      0.029 21269.5      3      9      54 2323180 17.1   6   0.1
[i]      624 2      0.054 20487.75      3   34      25 114042   6.1   4.5 0.3
[i]
[i]
[i]      6292 2      0.019 20945      3   19      836 8777972 4.3   4   0.0
[i]      6291 1      0.019 21240      3   44      292      298 8.9   6   0.4
[i]
[i] $echo$
[i] !This is a set of paired vacuum and air samples.  Ano is the air
[i] !sample number.  mconc is the air sample Der f 1 concentration.
[i] !cconc is cat air concentration.  Both in ng/m3.  Vno is vacuum
[i] !sample number.  Activity is 1 if none 2 if low 3 if moderate
[i] ! 4 if high.  Mngg is vacuum concentration for Der f 1.  Cngg
[i] !is vacuum conc for cat.  Area is vacuum sample area.  Time is
[i] !vacuum sample time.  Vol is air sample volume.
[i] $echo$
[i] $finish$
[i] ? $plot cngg cconc$
[O] 1.00e+07
[O] 9.50e+06
[O] 9.00e+06 C
[O] 8.50e+06
[O] 8.00e+06
[O] 7.50e+06
[O] 7.00e+06
[O] 6.50e+06
[O] 6.00e+06
[O] 5.50e+06
[O] 5.00e+06
[O] 4.50e+06
[O] 4.00e+06
[O] 3.50e+06
[O] 3.00e+06
[O] 2.50e+06 2
[O] 2.00e+06
[O] 1.50e+06
[O] 1.00e+06
[O] 5.00e+05

```

```

[o] 0.00e+00 3
[o] -----:-----:-----:-----:-----:-----:-----:
[o]          0.0      16.0      32.0      48.0      64.0      80.0      96.0
[i] ? $yvar cngg$error n$link i$fac cat 2$fac act 4$fit %gm$dis e$fit +cconc
[o] deviance = 5.731e+13
[o] d.f. = 6
[o]
[o]          estimate      s.e.      parameter
[o] 1      2266001.      1168169.      1
[o] scale parameter taken as 9.552e+12
[o]
[o] deviance = 5.731e+13 (change = -3275751424.)
[o] d.f. = 5 (change = -1 )
[o]
[i] ? $dis e$fit +act$dis e$fit +cat$dis e$
[o]          estimate      s.e.      parameter
[o] 1      2257127.      1383142.      1
[o] 2      1007.      59560.      CCON
[o] scale parameter taken as 1.146e+13
[o]
[o] deviance = 5.102e+13 (change = -6.295e+12)
[o] d.f. = 3 (change = -2 )
[o]
[o]          estimate      s.e.      parameter
[o] 1      2324794.      4126445.      1
[o] 2      -52.49      94980.      CCON
[o] 3      -2324636.      5828980.      ACT(2)
[o] 4      479081.      4611087.      ACT(3)
[o] 5      0.000      aliased      ACT(4)
[o] scale parameter taken as 1.701e+13
[o]
[o] deviance = 4.023e+13 (change = -1.079e+13)
[o] d.f. = 2 (change = -1 )
[o]
[o]          estimate      s.e.      parameter
[o] 1      -958806.      6344111.      1
[o] 2      -74.27      103299.      CCON
[o] 3      -2325304.      6339542.      ACT(2)
[o] 4      2120547.      5493140.      ACT(3)
[o] 5      0.000      aliased      ACT(4)
[o] 6      3284269.      4484960.      CAT(2)
[o] scale parameter taken as 2.011e+13
[o]
[i] ? !no relationship
[i] ? $calc lcconc=%log cconc$calc lcnngg=%log cngg$
[i] ? $plot lcconc lcnngg$
[o] 5.000
[o] 4.500
[o] 4.000
[o] 3.500
[o] 3.000
[o] 2.500
[o] 2.000
[o] 1.500
[o] 1.000
[o] 0.500
[o] 0.000
[o] -0.500

```

L

```

[o] -1.000 |
[o] -1.500 |
[o] -2.000 |
[o] -2.500 L
[o] -3.000 | L L
[o] -3.500 | L
[o] -4.000 L L L
[o] -4.500 |
[o] -5.000 |
[o] -----:-----:-----:-----:-----:-----:-----:
[o] 5.00 7.50 10.00 12.50 15.00 17.50 20.00
[i] ? $yvar lcconc$error n$link i$fac cat 2$fac act 4$fit %gm$dis e$fit +lcn
[w] -- model changed
[o] deviance = 49.476
[o] d.f. = 6
[o]
[o] estimate s.e. parameter
[o] 1 -2.254 1.085 1
[o] scale parameter taken as 8.246
[o]
[o] deviance = 47.578 (change = -1.898)
[o] d.f. = 5 (change = -1 )
[o]
[i] ? $dis e$fit +act$dis e$fit +cat$dis e$
[o] estimate s.e. parameter
[o] 1 -3.702 3.445 1
[o] 2 0.1231 0.2757 LCNG
[o] scale parameter taken as 9.516
[o]
[o] deviance = 0.72244 (change = -46.86)
[o] d.f. = 2 (change = -3 )
[o]
[o] estimate s.e. parameter
[o] 1 -3.396 1.264 1
[o] 2 0.01205 0.07583 LCNG
[o] 3 1.042 1.121 ACT(2)
[o] 4 -0.3455 0.7016 ACT(3)
[o] 5 7.337 0.8500 ACT(4)
[o] scale parameter taken as 0.3612
[o]
[o] deviance = 0.63212 (change = -0.09032)
[o] d.f. = 1 (change = -1 )
[o]
[o] estimate s.e. parameter
[o] 1 -3.447 1.677 1
[o] 2 -0.007538 0.1129 LCNG
[o] 3 0.8536 1.564 ACT(2)
[o] 4 -0.2285 0.9784 ACT(3)
[o] 5 7.337 1.124 ACT(4)
[o] 6 0.3383 0.8949 CAT(2)
[o] scale parameter taken as 0.6321
[o]
[i] ? !no relationship
[i] ? $scal ctot=cngg*dtot$scal csf=ctot/area$scal ta=time*area$
[i] ? $scal cta=ctot/ta$scal lcsf=%log csf$scal lcta=%log cta$
[i] ? $plot csf cconc$
[o] 200000. |
[o] 190000. |

```

```

[o] 180000. C
[o] 170000.
[o] 160000.
[o] 150000.
[o] 140000.
[o] 130000.
[o] 120000.
[o] 110000.
[o] 100000.
[o] 90000.
[o] 80000.
[o] 70000.
[o] 60000.
[o] 50000.
[o] 40000.
[o] 30000.
[o] 20000. 2
[o] 10000. C
[o] 0. 2
[o] -----:-----:-----:-----:-----:-----:
[o] 0.0 16.0 32.0 48.0 64.0 80.0 96.0
[i] ? $plot lcsf lcconcs$
[o] 13.600
[o] 12.800
[o] 12.000 L
[o] 11.200
[o] 10.400
[o] 9.600 L L L
[o] 8.800 L
[o] 8.000
[o] 7.200
[o] 6.400
[o] 5.600
[o] 4.800
[o] 4.000
[o] 3.200
[o] 2.400 L
[o] 1.600
[o] 0.800
[o] 0.000
[o] -0.800 L
[o] -1.600
[o] -2.400
[o] -----:-----:-----:-----:-----:-----:
[o] -4.00 -2.00 0.00 2.00 4.00 6.00 8.00
[i] ? $yvar lcsf$fac cat 2$fac act 4$error n$link i$fit %gm$dis e$fit +lccon
[w] -- model changed
[o] deviance = 127.21
[o] d.f. = 6
[o]
[o] estimate s.e. parameter
[o] 1 7.498 1.740 1
[o] scale parameter taken as 21.20
[o]
[o] deviance = 125.41 (change = -1.801)
[o] d.f. = 5 (change = -1 )
[o]
[i] ? $dis e$fit +cat$dis e$fit +act$dis e$

```

```
[o]      estimate      s.e.      parameter
[o]      1          7.928      2.482      1
[o]      2          0.1908     0.7120     LCCO
[o]      scale parameter taken as 25.08
```

```
[o] deviance = 122.28 (change = -3.124)
[o]    d.f. = 4      (change = -1      )
```

```
[o]      estimate      s.e.      parameter
[o]      1          6.581      5.025      1
[o]      2          0.09499     0.8413     LCCO
[o]      3          1.583      4.951     CAT(2)
[o]      scale parameter taken as 30.57
```

```
[o] deviance = 31.008 (change = -91.28)
[o]    d.f. = 1      (change = -3      )
```

```
[o]      estimate      s.e.      parameter
[o]      1          4.611      25.89      1
[o]      2         -0.2729      6.988      LCCO
[o]      3          4.327      5.977      CAT(2)
[o]      4         -10.10      10.19      ACT(2)
[o]      5          0.5897      6.994      ACT(3)
[o]      6          2.003      51.87      ACT(4)
[o]      scale parameter taken as 31.01
```

```
[i] ? !nothing is significant
[i] ? $fit -%gm$dis e$
[o] deviance = 31.008 (change = 0.)
[o]    d.f. = 1      (change = 0 )
```

```
[o]      estimate      s.e.      parameter
[o]      1         -0.2729      6.988      LCCO
[o]      2          4.611      25.89      CAT(1)
[o]      3          8.938      23.17      CAT(2)
[o]      4         -10.10      10.19      ACT(2)
[o]      5          0.5897      6.994      ACT(3)
[o]      6          2.003      51.87      ACT(4)
[o]      scale parameter taken as 31.01
```

```
[i] ? $plot lcta lcconcs$
```

```
[o] 12.000 |
[o] 11.200 |
[o] 10.400 | L
[o] 9.600  |
[o] 8.800  |
[o] 8.000  | L L
[o] 7.200  | L
[o] 6.400  |
[o] 5.600  |
[o] 4.800  |
[o] 4.000  |
[o] 3.200  |
[o] 2.400  |
[o] 1.600  |
[o] 0.800  | L
[o] 0.000  |
[o] -0.800 |
```

L

```

[ o ]      -1.600 |
[ o ]      -2.400 |          L
[ o ]      -3.200 |
[ o ]      -4.000 |
[ o ] -----:-----:-----:-----:-----:-----:-----:
[ o ]      -4.00      -2.00      0.00      2.00      4.00      6.00      8.00
[ i ] ? $yvar lcta$fac cat 2$fac act 4$error n$link i$fit %gm$dis e$fit +lccon
[ w ] -- model changed
[ o ] deviance = 134.41
[ o ] d.f. = 6
[ o ]
[ o ]      estimate      s.e.      parameter
[ o ]      1      5.783      1.789      1
[ o ]      scale parameter taken as 22.40
[ o ]
[ o ] deviance = 132.93 (change = -1.482)
[ o ] d.f. = 5 (change = -1 )
[ o ]
[ i ] ? $dis e$fit +cat$dis e$fit +act$dis e$
[ o ]      estimate      s.e.      parameter
[ o ]      1      6.173      2.555      1
[ o ]      2      0.1731      0.7330      LCCO
[ o ]      scale parameter taken as 26.59
[ o ]
[ o ] deviance = 129.12 (change = -3.814)
[ o ] d.f. = 4 (change = -1 )
[ o ]
[ o ]      estimate      s.e.      parameter
[ o ]      1      4.685      5.163      1
[ o ]      2      0.06718      0.8645      LCCO
[ o ]      3      1.749      5.087      CAT(2)
[ o ]      scale parameter taken as 32.28
[ o ]
[ o ] deviance = 31.357 (change = -97.76)
[ o ] d.f. = 1 (change = -3 )
[ o ]
[ o ]      estimate      s.e.      parameter
[ o ]      1      2.131      26.04      1
[ o ]      2      -0.3698      7.027      LCCO
[ o ]      3      4.704      6.011      CAT(2)
[ o ]      4      -10.16      10.25      ACT(2)
[ o ]      5      0.9148      7.034      ACT(3)
[ o ]      6      2.713      52.16      ACT(4)
[ o ]      scale parameter taken as 31.36
[ o ]
[ i ] ? $fit -%gm$dis e$
[ o ] deviance = 31.357 (change = 0.)
[ o ] d.f. = 1 (change = 0 )
[ o ]
[ o ]      estimate      s.e.      parameter
[ o ]      1      -0.3698      7.027      LCCO
[ o ]      2      2.131      26.04      CAT(1)
[ o ]      3      6.835      23.30      CAT(2)
[ o ]      4      -10.16      10.25      ACT(2)
[ o ]      5      0.9148      7.034      ACT(3)
[ o ]      6      2.713      52.16      ACT(4)
[ o ]      scale parameter taken as 31.36
[ o ]

```

[i] ? !nothing is significant
[i] ? !There is no relationship between surface samples for Fel d 1 and air
[i] ? !sample concentrations of Fel d 1 in this data set, even when high
[i] ? !activity and presence of a cat are taken into account
[i] ? \$stop\$