NUREG/CR-5262
SAND88-3093

PRAMIS: Probabilistic Risk Assessment Model Integration System

User's Guide

Prepared by R. L. Iman, J. D. Johnson, J. C. Helton

Sandia National Labortories

Prepared for
U.S. Nuclear Regulatory Commission

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NUREG/CR--5262

TI90 011244

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Manuscript Completed: June 1989
Date Published: May 1990

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NRC FIN A1393

ABSTRACT

This document has been designed for users of the Probabilistic Risk Assessment Model Integration System (PRAMIS) computer program developed by the authors at Sandia National Laboratories for easy assembly of the individual parts of the NUREG-1150 plant analyses into overall risk results. PRAMIS assembles the following files associated with the NUREG-1150 analyses in matrix format to obtain risk: the Latin hypercube sample, the results of the systems analysis, the results of the accident progression analysis, the results of the source term/partitioning analysis, and the results of the consequence analysis. In addition, various intermediate and conditional quantities are calculated when requested by user-specified input; the fractional contribution to risk of individual plant damage states, accident progression bins and source term groups are determined, and a file containing the original Latin hypercube sample and user-specified dependent variables is generated for use as input to the SAS statistical package. This report provides a tutorial that details how to use the PRAMIS program. The PRAMIS program is written in ANSI standard FORTRAN 77 to make the code as machine-independent (that is, portable) as possible.

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1. INTRODUCTION

One of the distinguishing features of NUREG-1150 (Ref.1) is the integration of uncertainty into the assessment of risk from commercial nuclear power plants. That is, each stage of the analysis has uncertainties associated with its individual entities. These uncertainties have been incorporated at each stage of the analysis and propagated through to the next stage. Currently, uncertainties are treated in the front-end or systems analysis, in the accident progression analysis, and in the source-term analysis as shown in Figure 1. The consequence analysis does not include uncertainty calculations. However, future plans call for the incorporation of uncertainties into this aspect of the analysis. The uncertainties are induced at each stage of the analysis via Monte Carlo techniques as manifested in the form of a Latin hypercube sample (Ref. 2).

In the system analysis the TEMAC program (Refs. 3 and 4) outputs frequencies for plant-damage states and associated uncertainties, which are in turn propagated through the accident progression analysis with the EVNTRE program (Ref. 5) and through the source term analysis with the XXSOR programs (Ref. 6). The consequence analysis is performed with the MACCS program (Ref. 7). These individual parts are linked together by carefully defined interfaces as follows:

a. The results of the systems analysis are grouped into plant damage states to provide the interface with the accident progression analysis.

b. The results of the accident progression analysis are grouped into accident progression bins to provide the interface with the source term analysis.

c. The results of the source term analysis are grouped into source term groups with the PARTITION program (Ref. 8) to provide the interface with the consequence analysis.

Each stage of the analysis is performed separately. Furthermore, due to the propagation of uncertainties through the systems analysis, accident progression analysis, and source term analysis, these parts of the analysis are repeated many times. It is of interest to study the impact of the uncertainty represented in the Latin hypercube sample vectors on the various consequences calculated by MACCS. This study is accomplished by utilizing several postprocessing programs to generate various graphical summaries and perform regression analyses. These analyses are set up by running the Probabilistic Risk Assessment Model Integration System (PRAMIS) program, which incorporates all of the information from the analysis as shown in Figure 1. In addition, PRAMIS is flexible enough to perform conditional analyses. For example, the analysis could proceed through the various stages conditional upon various specified entities such as certain plant damage states, or certain accident progression bins, or certain consequences. PRAMIS also allows for analyses based on calculations up through each stage of the analysis, such as after the source term calculations. That is, the calculations only have to progress sequentially through the stage of interest and do not have to proceed through consequences.

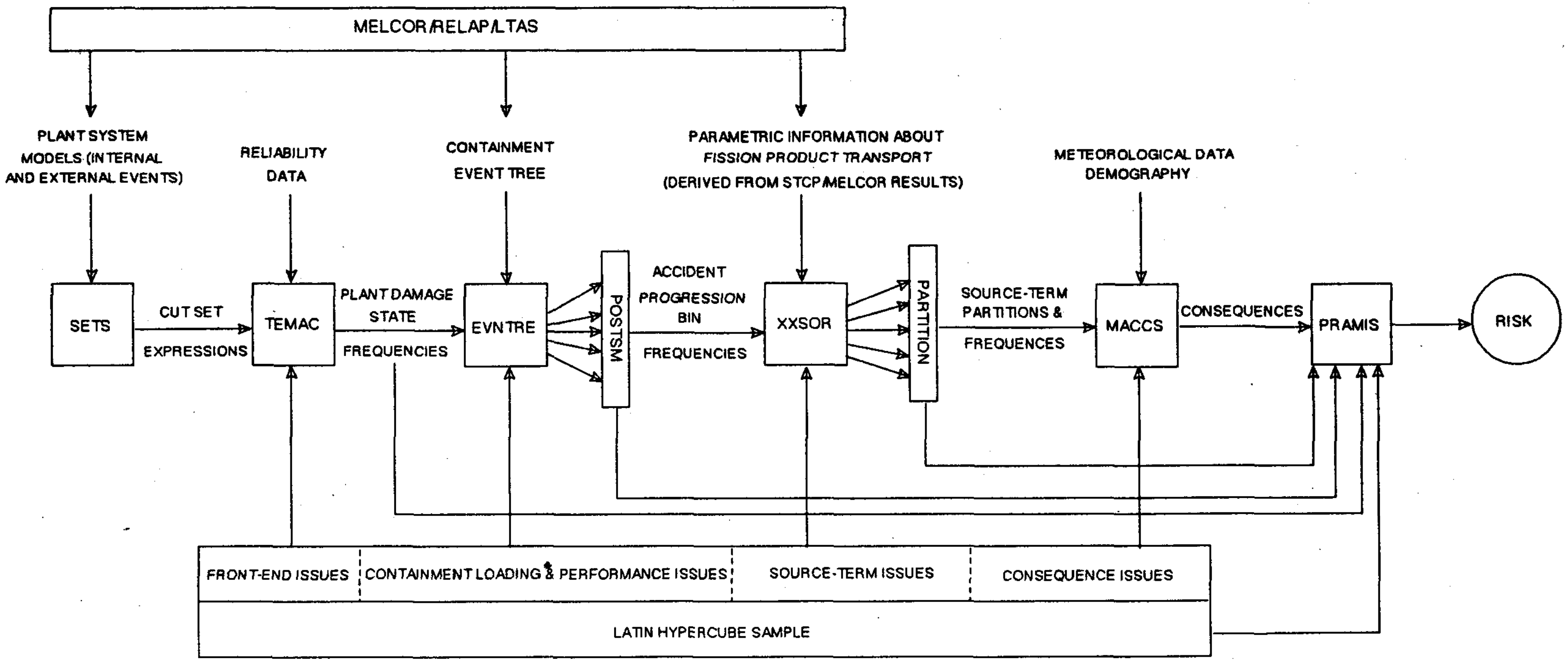

Figure 1. The Assembly of Various Components of the NUREG-1150 Analysis

The PRAMIS program is based on the following matrix formalism:

$$\mathbf{rC} = \mathbf{fPDS}\ \mathbf{P(PDS \rightarrow APB)}\ \mathbf{P(APB \rightarrow STG)}\ \mathbf{cSTG}, \tag{1}$$

where

rC = vector of risk associated with individual consequence measures (units: consequence per year)

fPDS = vector of plant damage state frequencies (obtained from the systems analysis with the TEMAC program)

P(PDS→APB) = matrix of transition probabilities from plant damage states to accident progression bins (obtained from the accident progression analysis with the EVNTRE program)

P(APB→STG) = matrix of transition probabilities from accident progression bins to source term groups (obtained from the source term analysis with the XXSOR programs and the subsequent source term grouping analysis with the PARTITION program)

cSTG = matrix of mean (over weather variability) consequence results for the individual source term groups (obtained with the MACCS program)

This formalism provides a convenient conceptual and computational means of drawing together the individual parts of the plant analyses. Latin hypercube sampling is used in the propagation of uncertainties through the systems analysis, accident progression analysis, and source term analysis for the individual plants studied in NUREG-1150. As a result, the terms **fPDS**, **P(PDS→APB)**, and **P(APB→STG)** change for each sample vector.

The following operations are performed by PRAMIS to assemble the NUREG-1150 analyses: (1) files containing the Latin hypercube sample and the results of the systems analysis, accident progression analysis, source term/partitioning analysis, and consequence analysis are read; (2) the terms **fPDS**, **P(PDS→APB)**, **P(APB→STG)**, and **cSTG** are constructed; (3) the product in Equation (1) is evaluated to obtain risk; in addition, various intermediate and conditional quantities are calculated when requested by user-specified input; (4) the fractional contribution to risk of individual plant damage states, accident progression bins and source term groups is determined; and (5) a file containing the original Latin hypercube sample and user-specified dependent variables is generated for use as input to the SAS® statistical package. Since SAS is a widely used and well-documented statistical package, generation of PRAMIS output in a form suitable for use with this statistical package makes a great variety of previously tested and documented statistical and graphical procedures available for use in the analysis of the results generated in NUREG-1150.

A detailed discussion is given for each of the matrices in Equation (1) in the next section.

2. STRUCTURE OF THE NUREG-1150 ANALYSIS

The individual NUREG-1150 plant studies are level 3 probabilistic risk assessments. As such, they consist of four components:

1. systems analysis, which estimates the frequency of core damage,

2. accident progression analysis, which determines the possible ways in which an accident could evolve given core damage,

3. source term analysis, which estimates the source terms (that is, environmental releases) for specific accident conditions,

4. consequence analysis, which estimates the health and economic impacts of the individual source terms.

The NUREG-1150 plant studies are fully integrated probabilistic risk assessments in the sense that calculations leading to both risk and uncertainty in risk are carried through all four of the above components of the individual plant studies. The calculation of risk proceeds in a manner whereby the effects of each initiating event are traced directly through the entire analysis to arrive at a specific consequence. The frequency of the initiating event, the conditional probability of the paths leading to the consequence, and the value of the consequence itself can then be combined to obtain a risk measure. Measures of uncertainty in risk are obtained by repeating the calculation just indicated many times with different values for important parameters. This provides a distribution of risk estimates that can be used as a measure of the uncertainty in risk.

Three important ideas recur in association with each of the four components of the NUREG-1150 analyses:

1. Use of all available sources of information for each analysis component, including past observational data, experimental data, mechanistic modeling and, as appropriate or necessary, expert judgment.

2. Use of relatively quick running models to assemble and manipulate the data developed for each analysis component.

3. Definition of well-defined interfaces between the individual analysis components.

It is important to recognize that a probabilistic risk assessment is a procedure for assembling and organizing information from many sources; the models actually used in the computational framework of a probabilistic risk assessment serve to organize this information and, as a result, are rarely as detailed as most of the models that are actually used in the original generation of this information.

Each of the individual modeling components is now discussed. The three ideas just indicated will recur in each area. Furthermore, a matrix representation (Refs. 9 and 10) is introduced to show how the overall integrated analysis fits together and how the progression of an accident can be traced *from initiating event to consequence*. This representation facilitates both the conceptual description and the computational implementation of the NUREG-1150 analyses.

Systems Analysis. The systems analysis uses event tree and fault tree techniques to investigate the manner in which various initiating events can lead to core damage. In initial detailed analyses, the SETS program (Ref. 11) is used to combine experimental data, past observational data and modeling results into estimates of core damage frequency. The ultimate outcome of the initial systems analysis for each plant is a group of minimal cut sets that lead to core damage. Detailed descriptions of the systems analyses for the individual plants are available elsewhere (Refs. 12-16). For the final integrated NUREG-1150 analysis for each plant, the group of risk-significant minimal cut sets is used as the systems model. In the integrated analysis, the TEMAC program (Refs. 3 and 4) is used to evaluate the minimal cut sets. The minimal cuts themselves are formed into groups called plant damage states, where all minimal cut sets in a plant damage state provide a similar set of conditions for the subsequent accident progression analysis. Thus, the plant damage states form the interface between the systems analysis and the accident progression analysis.

As indicated earlier, a representation based on transition matrices facilitates the description and implementation of the NUREG-1150 analyses. For the systems analysis component, this representation has the form

$$\mathbf{fPDS} = \mathbf{fIE}\ \mathbf{P}(\mathbf{IE}\rightarrow\mathbf{PDS}), \tag{2}$$

where **fPDS** is the vector of frequencies for the plant damage states, **fIE** is the vector of frequencies for the initiating events, and **P(IE→PDS)** is the matrix of transition probabilities from initiating events to plant damage states. Specifically,

$\mathbf{fIE} = [fIE_1, \ldots, fIE_{nIE}]$,

fIE_i = frequency per year for initiating event i,

nIE = number of initiating events,

$fPDS = [fPDS_1, \ldots, fPDS_{nPDS}]$,

$fPDS_j$ = frequency per year for plant damage state j,

$nPDS$ = number of plant damage states,

$$\mathbf{P}(\mathbf{IE}\rightarrow\mathbf{PDS}) = \begin{bmatrix} pPDS_{11} & \cdots & pPDS_{1,nPDS} \\ \vdots & & \vdots \\ pPDS_{nIE,1} & \cdots & pPDS_{nIE,nPDS} \end{bmatrix}$$

and

$pPDS_{ij}$ = probability that initiating event i will lead to plant damage state j.

The elements $pPDS_{ij}$ of **P(IE→PDS)** are conditional probabilities: given that initiating event *i* has occurred, $pPDS_{ij}$ is the probability that plant damage state *j* will also occur.

The elements of **P(IE→PDS)** are determined in the analysis of the previously indicated minimal cut sets with the TEMAC program. In turn, both the cut sets and the data used in their analysis come from earlier studies that draw on many sources of information. Thus, the elements $pPDS_{ij}$ of **P(IE→PDS)** are, in reality, functions of the many sources of information that went into the systems analysis.

<u>Accident Progression Analysis</u>. The accident progression analysis uses event tree techniques to determine the possible ways in which an accident might evolve from each plant damage state. Specifically, a single event tree is developed for each plant and implemented with the EVNTRE (Ref. 5) computer program. The characterizations for the individual plant damage states provide enough information to answer a set of initial questions on the accident progression event trees as well as certain questions later in the trees. The answering of these questions provides the link between the systems analysis and the accident progression analysis. Detailed descriptions of the accident progression analyses for the individual plants are available elsewhere (Refs. 17-20). Due to the large number of questions on the NUREG-1150 accident progression event trees and the fact that many of these questions have more than two outcomes, there are far too many paths through each tree to permit their individual consideration in subsequent source term and consequence analysis. Therefore, the paths through the trees are grouped into accident progression bins, where each bin is a group of paths through the event tree that define a similar set of conditions for source term analysis. The properties of each accident progression bin define the conditions under which a source term estimate will be made.

Like the systems analysis, the accident progression analysis involves (1) use of all available sources of information, (2) use of a relatively quick running model to assemble and manipulate the data, and (3) definition of a well-defined interface with the next analysis component. Specifically, past observational data, experimental data, mechanistic code calculations and expert judgment were used in the development and parameterization of a model for accident progression. This information was coalesced into an event tree that was evaluated with the EVNTRE program. Finally, the results of the event tree analysis were grouped into accident progression bins to provide the necessary interface with the source term analysis.

The transition matrix representation used for the systems analysis can also be used to summarize the accident progression analysis. For the accident progression analysis, this representation has the form

$$\mathbf{fAPB} = \mathbf{fPDS}\ \mathbf{P(PDS \rightarrow APB)}, \tag{3}$$

where **fPDS** is the vector of frequencies for the plant damage states defined in (2), **fAPB** is the vector of frequencies for the accident progression bins, and **P(PDS→APB)** is the matrix of transition probabilities from plant damage states to accident progression bins. Specifically,

$\mathbf{fAPB} = [fAPB_1, \ldots, fAPB_{nAPB}]$,

$fAPB_k$ = frequency per year for accident progression bin k,

$nAPB$ = number of accident progression bins,

$$\mathbf{P(PDS{\rightarrow}APB)} = \begin{bmatrix} pAPB_{11} & \cdots & pAPB_{1,nAPB} \\ \vdots & & \vdots \\ pAPB_{nPDS,1} & \cdots & pAPB_{nPDS,nAPB} \end{bmatrix}$$

and

$pAPB_{jk}$ = probability that plant damage state j will lead to accident progression bin k.

The properties of **fPDS** are given in conjunction with (2). The elements $pAPB_{jk}$ of **P(PDS→APB)** are determined in the accident progression analysis with EVNTRE for the individual plant damage states.

Source Term Analysis. As in the systems analysis and the accident progression analysis, the source term analysis draws on many sources of information. For example, extensive calculations were performed with the Source Term Code Package in support of NUREG-1150 (Ref. 21). These calculations, additional calculations with MELCOR and other mechanistic models, experimental results, and expert judgment supported the source term analysis. The information from these sources was assembled in the context of the integrated NUREG-1150 analyses with relatively simple parametric models implemented in the XXSOR programs (Ref. 6). The XXSOR programs provided a source term estimate for each accident progression bin identified in the accident progression analyses.

As a large number of accident progression bins were identified in the integrated analysis for each plant and the consequence model used in NUREG-1150 (that is, MACCS, Ref. 7) was considerably more expensive to evaluate than the XXSOR programs, it was not practical to perform a consequence calculation for every source term. Therefore, to form an interface between the source term analysis and the consequence analysis, the source terms estimated in the source term analysis were combined into source term groups, where each group is a collection of source terms that define similar conditions for consequence analysis.

The transition matrix representation can be continued for the source term analysis and takes the form

$$\mathbf{fSTG} = \mathbf{fAPB}\ \mathbf{P(APB{\rightarrow}STG)}, \tag{4}$$

where **fAPB** is the vector of frequencies for the accident progression bins defined in (3), **fSTG** is the vector of frequencies for the source term groups, and

P(APB→STG) is the matrix of transition probabilities from accident progression bins to source term groups. Specifically,

$\mathbf{fSTG} = [fSTG_1, \ldots, fSTG_{nSTG}]$,

$fSTG_\ell$ = frequency per year for source term group ℓ,

$nSTG$ = number of source term groups,

$$\mathbf{P(APB \rightarrow STG)} = \begin{bmatrix} pSTG_{11} & \cdots & pSTG_{1,nSTG} \\ \vdots & & \vdots \\ pSTG_{nAPB,1} & \cdots & pSTG_{nAPB,nSTG} \end{bmatrix}$$

and

$pSTG_{k\ell}$ = probability that accident progression bin k will be assigned to source term group ℓ.

= 1 if accident progression bin k is assigned to source term group ℓ

= 0 otherwise.

The properties of **fAPB** are given in conjunction with (3).

Consequence Analysis. The source term analysis and the subsequent formation of source term groups is followed by the consequence analysis. This analysis component uses the MACCS program to estimate various consequence measures for each source term group. Like the other analysis components, the consequence analysis draws on many sources of information and integrates this information to provide consequence estimates for each source term group. The results for each group include estimates for both mean consequences and distributions of consequences. The mean consequence results can be combined with the source term group frequencies to produce overall measures of risk. When the distributions of consequence measures are saved it is also possible to combine consequence distributions across source term groups to produce overall distributions of risk.

When the transition matrix formalism is used, the representation for risk becomes

$$\mathbf{rC} = \mathbf{fSTG}\ \mathbf{cSTG}, \tag{5}$$

where **fSTG** is the vector of frequencies for the source term groups defined in (4), **rC** is the vector of risk measures, and **cSTG** is the matrix of mean consequence measures conditional on the occurrence of individual source term groups, Specifically,

$\mathbf{rC} = [rC_1, \ldots, rC_{nC}]$,

rC_m = risk (consequence per year) for consequence measure m,

nC = number of consequence measures,

$$\mathbf{cSTG} = \begin{bmatrix} cSTG_{11} & \cdots & cSTG_{1,nC} \\ \vdots & & \vdots \\ cSTG_{nSTG,1} & \cdots & cSTG_{nSTG,nC} \end{bmatrix}$$

and

$cSTG_{\ell m}$ = mean value (over weather) of consequence measure *m* conditional on the occurrence of source term group ℓ.

The properties of **fSTG** are given in conjunction with (4). The elements $cSTG_{\ell m}$ of **cSTG** are determined from consequence calculations with MACCS for individual source term groups.

The equations in (2) through (5) can be combined to obtain the following representation for risk as previously given in Equation (1):

$$\mathbf{rC} = \mathbf{fIE}\ \mathbf{P(IE{\rightarrow}PDS)}\ \mathbf{P(PDS{\rightarrow}APB)}\ \mathbf{P(APB{\rightarrow}STG)}\ \mathbf{cSTG}. \tag{6}$$

The preceding expression shows how the integrated analysis propagates from the initiating event frequencies all the way through to consequence risk measures.

The integrated NUREG-1150 analyses use Monte Carlo procedures as a basis for both uncertainty and sensitivity analysis. With this approach, a sequence

$$X_1,\ X_2,\ \ldots,\ X_{nV} \tag{7}$$

of nV potentially important variables is identified for use in uncertainty and sensitivity analysis. Then, expert review panels are used to assess the uncertainty in these variables, and formal decision analysis techniques (Ref. 22) are used to aggregate the assessments of the individual panel members into a sequence of distributions

$$D_1,\ D_2,\ \ldots,\ D_{nV}, \tag{8}$$

where D_i is the distribution assigned to variable X_i.

Then, the Latin hypercube sampling program (Ref. 23) is used to obtain the variable values that will actually be propagated through the integrated analysis. The result of generating a sample from the variables in (7) with the distributions in (8) is a sequence

$$S_i = [X_{i1}, X_{i2}, \ldots, X_{i,nV}], \; i = 1, 2, \ldots, nLHS, \tag{9}$$

of sample elements, where X_{ij} is the value for variable X_j in sample vector *i* and nLHS is the number of sample vectors. The expression in (6) is determined for each element of the sample. This creates a sequence of results of the form

$$\begin{aligned} \mathbf{rC}_i &= \mathbf{fIE}_i \; \mathbf{P}_i(\mathbf{IE}\rightarrow\mathbf{PDS}) \; \mathbf{P}_i(\mathbf{PDS}\rightarrow\mathbf{APB}) \; \mathbf{P}_i(\mathbf{APB}\rightarrow\mathbf{STG}) \; \mathbf{cSTG} \\ &= \mathbf{fPDS}_i \; \mathbf{P}_i(\mathbf{PDS}\rightarrow\mathbf{APB}) \; \mathbf{P}_i(\mathbf{APB}\rightarrow\mathbf{STG}) \; \mathbf{cSTG} \end{aligned} \tag{10}$$

where the subscript *i* is used to denote the evaluation of the expression in (6) with the *i*th sample vector in (9). The uncertainty and sensitivity analyses in NUREG-1150 are based on the calculations summarized in (10). Since **fPDS**, **P(PDS→APB)** and **P(APB→STG)** are based on results obtained with TEMAC, EVNTRE and the appropriate XXSOR program, determination of the expression in (10) requires the use of these models with the *i*th sample element. The matrix **cSTG** in (10) is not subscripted because the NUREG-1150 analyses do not include consequence modeling uncertainty (other than stochastic variability due to weather conditions).

3. USING PRAMIS TO ASSEMBLE THE PRA MATRICES

The PRAMIS computer program has been developed to assemble the matrices discussed in the previous section. PRAMIS has the flexibility to either assemble all of the matrices in their full dimensions all the way through the analysis, or to produce conditional analyses by assembling subsets of the matrices. The conditional analyses may proceed all the way through consequence calculations or may stop short of consequences if some intermediate output is of interest.

The PRAMIS program is quite simple to use and executes very quickly. The CPU times required to execute PRAMIS for all four of the plants considered in the NUREG-1150 analysis ranged from 1 to 20 minutes on a VAX 8650, depending on the number of source terms generated for a specific plant and the number of vectors in the Latin hypercube sample. To execute PRAMIS the names of six files created in the NUREG-1150 analysis for a specific plant must be assembled in an input file named **PRAMIS.INP**. A partial listing of these files is given in Appendix D and a brief description of these files is as follows:

1. The Latin hypercube sample file containing the LHS vectors produced by the LHS program. The name of this file follows the keyword **SMP**. This file follows the usual format for an LHS file (an nLHS × nV matrix with each row preceded by integers specifying the row number and the value of nV).

2. The plant damage state frequency file produced by the TEMAC program. The name of this file follows the keyword **PDS**. This file follows the usual format for a TEMAC file (an nLHS × nPDS matrix with each row preceded by integers specifying the row number and the value of nPDS).

3. The master bin list file, which contains the multi-character names for the accident progression bins. The name of this file follows the keyword **MBL**. The first record of this file is a title, the second record contains the number of APB attributes (see page 13) and nAPB, followed by a listing of the

nAPB accident progression bins included in the analysis. The master bin list file contains a list of all (that is, selected at least once for some sample vector) APBs appearing in the analysis.

4. The accident progression bin file containing the accident progression bins and their corresponding conditional probabilities for each of the vectors in the LHS file. The name of this file follows the keyword **APB**. Record 1 of this file contains a title while record 2 contains three integers: the number of APB attributes, nLHS, and nPDS. The remaining records are grouped by LHS vector and PDS as follows: the first record within a group contains three integers: the LHS vector number i, the PDS number j, and the number of APBs associated with PDS j for LHS vector i, and these three integers are followed by the total frequency for PDS j. This record is followed by a listing of the APBs and their conditional probabilities given the occurrence of PDS j.

5. The pointer file that associates each accident progression bin with one of the source term groups created by the PARTITION program. The name of this file follows the keyword **PAR**. The first record of this file contains a title, with the second record containing the integers nSTG, nAPB, and nLHS. These records are followed by an nLHS $\times$ nAPB matrix of integers where the (i,j) element of this matrix identifies the number of the source term group to which the *jth* APB is assigned. The presence of a zero in this file signifies that an APB did not occur for the particular sample vector under consideration.

6. The consequence file containing mean consequence results generated by MACCS for each of the groups created by the PARTITION program. The name of this file follows the keyword **CSQ**. There are nSTG $\times$ (nCSQ + 1) records in this file. The first record in this file identifies a source term group. This record is followed by nCSQ records that contain the magnitude of each of the nCSQ consequences. This set of records is repeated for each of the nSTG source term groups.

The files indicated in 2, 4, and 5 contain results on a per sample vector basis, whereas the files in 3 and 6 do not.

The input file PRAMIS.INP, as specified for a VAX 8650, is of the following form (except for the line numbers that have been added to aid the discussion).

1. Surry Base Case, 6/15/89
2. **SMP** [RLIMAN.PRAMIS]LHS.DAT
3. **PDS** [RLIMAN.PRAMIS]PDS.DAT
4. **MBL** [RLIMAN.PRAMIS]MBL.DAT
5. **APB** [RLIMAN.PRAMIS]APB.DAT
6. **PAR** [RLIMAN.PRAMIS]PAR.DAT
7. **CSQ** [RLIMAN.PRAMIS]CSQ.DAT
8. **NAM** SURRY
9. **END** CSQ

Record number 1 in the PRAMIS.INP file is simply a title that appears on the output. The three-letter identifiers at the start of records 2-9 are required by PRAMIS. Records 2-7 may appear in any order, and are used to identify the names of the six files needed for the analysis. The VAX convention is used to name the files and all are assumed to be found in subdirectory PRAMIS of user RLIMAN. Record number 8 is used to name the output files created by PRAMIS, and may contain up to eight characters. Record number 9 is used to signal the stopping point for the assembly of the matrices by PRAMIS. In this case the keyword **END** is followed by the keyword **CSQ** to signify that the assembly should proceed all the way through consequences. Other possible stopping points in the assembly would be identified by the keywords **PDS**, **APB**, and **PAR**.

The base case analysis for the Surry plant will be used to demonstrate the operation of PRAMIS, although the matrices **P(PDS→APB)** and **P(APB→STG)** are too large to include in this report. The values of the parameters identified in the previous section for the Surry analysis are as follows:

nPDS = 7
nAPB = 1906
nSTG = 52
nCSQ = 9
nLHS = 200

Conditional Analyses. Ordinarily, PRAMIS would be set up to assemble the PRA matrices all the way through consequence calculations. PRAMIS can be made to stop short of consequence calculations by changing the value of the END parameter in the PRAMIS.INP file as mentioned in the preceding discussion. The possible stopping points in the assembly are PDS, APB, PAR and CSQ, corresponding to plant damage states, accident progression bins, partition groups, and consequences, respectively. For example, if the END parameter is set as

END PDS

then PRAMIS will assemble only the LHS and PDS matrices as identified in the PRAMIS.INP file. In general, PRAMIS will assemble the matrices in a sequential manner starting with the LHS matrix and continuing through the designated stopping point for the analysis. As an illustration of the modification of the PRAMIS.INP for a conditional analysis, suppose the following characteristics are desired:

1. Only PDSs 3, 4, and 5 are to be used from the seven PDSs.

2. Only those APBs corresponding to alpha mode failure are desired.

3. Only groups 9 through 14 from the PARTITION program are to be used.

4. Only consequences 2, 5, and 7 are examined from the nine consequences that are calculated by MACCS.

To perform this conditional analysis, records 3, 5, 6, and 7 of the PRAMIS.INP file would be modified as follows:

```
1. Surry Base Case, 5/15/89
2. SMP [RLIMAN.PRAMIS]LHS.DAT
3. PDS [RLIMAN.PRAMIS]PDS.DAT 3 4 5
4. MBL [RLIMAN.PRAMIS]MBL.DAT
5. APB [RLIMAN.PRAMIS]APB.DAT 1CDEFG * 5D * 6C
6. PAR [RLIMAN.PRAMIS]PAR.DAT 9 10 11 12 13 14
7. CSQ [RLIMAN.PRAMIS]CSQ.DAT 2 5 7
8. NAM SURRY
9. END CSQ
```

The modifications on records 3, 6, and 7 are obvious. The modification of record 5 requires some additional explanation. For the Surry plant, the APBs have an 11-character descriptor, where each descriptor character represents a particular attribute and can take on several different values. The possible characteristics for Surry are listed in the following two-way table.

	ATTRIBUTE										
	1	2	3	4	5	6	7	8	9	10	11
CHARACTERISTIC	A	A	A	A	A	A	A	A	A	A	A
	B	B	B	B	B	B	B	B	B	B	B
	C	C	C	C	C	C	C		C	C	
	D	D	D	D	D		D		D	D	
	E	E	E								
	F	F	F								
	G	G									
		H									

The values on record number 5 are used to indicate that alpha mode failure is defined by those APBs for which

attribute 1 has characteristics C, D, E, F, or G

and

attribute 5 has characteristic D

and

attribute 6 has characteristic C.

The connector "+" can also be used to join attributes on record number 5, but is not needed *within* a given attribute.

The number of possible conditional analyses that can be generated by PRAMIS is quite large. In fact, the number of such analyses that could be performed through consequence calculations for Surry is found as

$$(2^{nPDS} - 1)(2^7 2^8 2^6 2^4 2^4 2^3 2^4 2^2 2^4 2^4 2^2)(2^{nSTG} - 1)(2^{nC} - 1)$$

$$\approx (2^7)(2^7 2^8 2^6 2^4 2^4 2^3 2^4 2^2 2^4 2^4 2^2)(2^{17})(2^9) = 2^{81} \approx 2.4E24$$

Of course, from a practical point of view, this number of analyses would be reduced considerably in practice through engineering judgment, as most combinations would not be of interest.

Analyses for APBs not immediately identifiable by using record number 5. Sometimes it may not be possible to select a group of APBs by using record number 5. In such cases, PRAMIS allows a file to be input containing a listing of the 11-character descriptors for the APBs of interest. For example, in the Surry analysis four groupings of APBs were used for various phenomena. One group containing steam generator tube ruptures was obtained by modifying record 5 to select "6AB." A second group created for Event V was obtained by modifying record 5 to select "1AB." The third group was the alpha mode failure shown above. The last group contained the residual APBs that were not identified in the first three groups.

A SAS program (explained in the Appendix) was written to create a file whose records consist only of the 11-character descriptors for the APBs of interest. PRAMIS reads this file and subsequently selects only those APBs whose 11-character descriptors are found in the file. When such a file is to be used, it is necessary to add another record to the PRAMIS.INP file. This record must start with the three-letter identifier **BIN**, and must be followed by the name of the file that contains the listing of the APBs of interest. For example, if the record

BIN OTHER.DAT

is added to PRAMIS.INP, the PRAMIS will search for a file named OTHER.DAT to determine the list of APBs to be used in the analysis. The presence of the BIN record in the PRAMIS.INP file will override any APBs specified on record 5. That is, the APBs can be specified either through use of record 5 or through use of the BIN record, but not by both simultaneously.

Output files created by PRAMIS. Once the matrices have been specified for assembly in the PRAMIS.INP file as described above, execution of the PRAMIS program creates a matrix that is output to a file with the extension **REG**. The name of this file is determined by the keyword NAM on record number 8 of the PRAMIS.INP file. For the above sample input files, this file will be named SURRY.REG.

The first nV columns of the matrix in SURRY.REG will contain the values of the variables in the Latin hypercube sample. The number of remaining columns in SURRY.REG will vary depending on the stopping point specified in the matrix assembly and any restrictions that may have been specified with some of the keywords. For example, if the keyword END has been used to specify the assembly of matrices through consequences, and the keyword CSQ has not been modified, then the results for all nCSQ consequences will be included in the last nCSQ columns of the matrix that is stored in the file SURRY.REG. This matrix will have dimensions of nLHS × (nV + nCSQ), where nV is the number of variables sampled in the LHS matrix.

This file can be processed in several different ways to produce information with respect to the analysis. Many of the methods for processing the output are explained in Section 5. PRAMIS also produces a file with an OUT extension (in this example the file name is SURRY.OUT), which contains a record of the analysis with respect to files used, the options requested, and the size of the matrices that are assembled. This file will also contain the results of fractional contributions (explained in the next section) whenever they are requested.

4. USING PRAMIS TO COMPUTE FRACTIONAL CONTRIBUTIONS

A question that is frequently of interest with respect to PRA analyses is what is the fractional contribution to risk attributable to some entity such as individual plant damage states. For example, what is the fractional contribution to early fatality risk by plant damage state? There are two different ways to respond to this question and each produces a different result. Consider the following matrix of size nLHS × nPDS, where X_{ij} represents the magnitude of some risk measure by plant damage state and Latin hypercube vector.

$$\mathbf{X} = \begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1,nPDS} \\ X_{21} & X_{22} & \cdots & X_{2,nPDS} \\ \vdots & \vdots & & \vdots \\ X_{nLHS,1} & X_{nLHS,2} & \cdots & X_{nLHS,nPDS} \end{bmatrix}$$

<u>Method 1</u>. Let $Z_{ij} = X_{ij} / \sum_{k=1}^{nPDS} X_{ik}$

$$\text{Compute } \bar{Z}_j = \sum_{i=1}^{nLHS} Z_{ij} \; / \; nLHS$$

The statistic $\bar{Z}_j$ represents the *average fractional contribution to risk.* That is, the *i*<u>th</u> row of the matrix **Z** represents fractions derived by dividing the *i*<u>th</u> row of the matrix **X** by the total of the *i*<u>th</u> row. Thus, nLHS estimates of the fractional contribution to the consequence are obtained for PDS_j and $\bar{Z}_j$ is the average of the estimates. Since there are nLHS estimates of the fractional contribution to early fatalities, all of the uncertainty information is available in addition to the average fractional contribution when this method is used.

<u>Method 2</u>. Let $\bar{T}_j = \sum_{i=1}^{nLHS} X_{ij} \; / \; \sum_{i=1}^{nLHS} \sum_{k=1}^{nPDS} X_{ik}$

This method produces the *fractional contribution to the average risk* for PDS_j. This method produces a single number and contains no uncertainty information. In addition, it is extremely sensitive to large or unusual observations in the matrix **X**.

Quite simply put, Method 1 calculates the expected value of a ratio, that is, E(a/b), whereas Method 2 calculates the ratio of expected values, that is, E(a)/E(b). PRAMIS has the capability of generating either of the above measures for risks derived from consequence results for the following areas of interest.

1. Fractional contribution of plant damage state to each consequence risk.

2. Fractional contribution of partition groups to each consequence risk.

3. Fractional contribution of accident progression bin attributes to each consequence risk.

4. Fractional contribution by accident progression bin characteristic within accident progression bin attribute to each consequence risk.

5. Fractional contribution of accident progression bin to each consequence risk.

The calculation of fractional contributions is performed when the user adds the keyword **FRC** to the PRAMIS.INP file. This keyword has three options as follows:

FRC SMP - Fractional contributions are calculated by Method 1.

FRC GLB - Fractional contributions are calculated by Method 2.

FRC ALL - Fractional contributions are calculated by both Method 1 and 2.

Appendix B contains a portion of the output that is contained in the SURRY.OUT file from PRAMIS for the Surry plant when the keyword FRC SMP is specified in the PRAMIS.INP file. Likewise, Appendix C contains a portion of the output from SURRY.OUT when the keyword FRC GLB is specified.

Whenever the FRC keyword is used PRAMIS creates two output files with the extensions **PDS** and **PAR**. The names of the files are designated as before by the NAM keyword. Therefore, for the present example these files would be named SURRY.PDS and SURRY.PAR. The SURRY.PDS file contains the risk results by plant damage state, which are stored in this file in the form of the nLHS $\times$ nPDS matrix **X** given above. The SURRY.PAR file is similar to the SURRY.PDS file, except that it contains the risk results for each of the source term groups formed by the PARTITION program, and these results are stored in this file as a nLHS $\times$ nSTG matrix. A graphical display of fractional contribution for Method 1 is discussed in the next section.

5. PROCESSING THE MATRICES ASSEMBLED BY PRAMIS

As mentioned at the end of Section 3, once the matrix assembly has been completed by PRAMIS, a file is output with the extension REG. If the matrices have been assembled through consequences, and include all nC consequences, then the output matrix will have dimensions of nLHS $\times$ (nV + nC) where nV is the number of sampled variables in the LHS matrix. This section demonstrates some of the ways that the REG file can be processed to produce information with respect to the analysis. Much of this processing is done with the software package SAS® and although the following programs are listed in Appendix A, the user must have some degree of familiarity with SAS to be able to modify these programs for an analysis. It is not realistic to expect that PRAMIS can do all of the various analyses, since modifications are needed from one application to the next. Copies of all of the programs listed in Appendix A can be obtained on a floppy disk by contacting the authors of this report.

Program Number 1: Creating a SAS Data Set. The REG file output created by PRAMIS has to be converted to a SAS data set to speed up the subsequent processing by SAS. This program contains labels for all of the variables that are to be retained for subsequent analyses. Labels are automatically taken care of on any future processing step with SAS that uses the SAS data set created by this program. A SAS data set is always identifiable by the extension SSD. For this program the SAS data set is named SURRY.SSD.

Program Number 2: Obtaining Summary Statistics. Summary statistics including minimum, maximum, various quantiles, means, standard deviation, and many other measures, along with a listing of the five smallest and the five largest observations, can be obtained by using the SAS procedure PROC UNIVARIATE. This program uses the SAS data set SURRY.SSD and outputs summary statistics for any variable in the file that is specified by the user. The listing below shows the output from this program for early fatalities for Surry.

SUMMARY STATISTICS FOR SURRY - EARLY FATALITIES

VARIABLE=C1 EARLY FATALITIES

MOMENTS

N	200	SUM WGTS	200
MEAN	1.979E-06	SUM	.000395826
STD DEV	9.944E-06	VARIANCE	9.888E-11
SKEWNESS	7.56389	KURTOSIS	61.2469
USS	2.046E-08	CSS	1.968E-08
CV	502.437	STD MEAN	7.031E-07
T:MEAN=0	2.81471	PROB>|T|	0.00537271
SGN RANK	10050	PROB>|S|	0.0001
NUM ^= 0	200		

QUANTILES(DEF=4)

100% MAX	0.0000974	99%	.000073459
75% Q3	3.322E-07	95%	7.785E-06
50% MED	7.030E-08	90%	2.225E-06
25% Q1	8.250E-09	10%	2.029E-09
0% MIN	1.400E-11	5%	7.374E-10
		1%	4.223E-11
RANGE	0.0000974		
Q3-Q1	3.240E-07		
MODE	1.100E-09		

EXTREMES

LOWEST	HIGHEST
1.400E-11	0.0000127
4.120E-11	0.0000349
1.440E-10	0.0000595
2.250E-10	0.0000736
2.500E-10	0.0000974

Program Number 3: Finding only the Maximum and Minimum Values. For some applications only the maximum and minimum values are of interest. For example prior to constructing a graph to display all of the results for a given consequence measure it is helpful to know the values of the maximum and minimum values. This program uses the SAS data set SURRY.SSD and outputs the maximum and minimum values for each consequence measure. The listing below shows the output from this program for early fatalities for Surry.

MINIMUM AND MAXIMUM CONSEQUENCES FOR SURRY

CMIN1	CMAX1	CMIN2	CMAX2	CMIN3	CMAX3
1.400E-11	9.740E-05	5.980E-10	1.320E-03	9.930E-14	3.800E-07
CMIN4	CMAX4	CMIN5	CMAX5	CMIN6	CMAX6
7.780E-05	7.470E-02	1.600E-03	7.300E-01	4.740E-03	4.540E+00
CMIN7	CMAX7	CMIN8	CMAX8	CMIN9	CMAX9
1.470E+02	3.600E+05	5.050E-13	6.490E-07	4.030E-11	4.790E-08

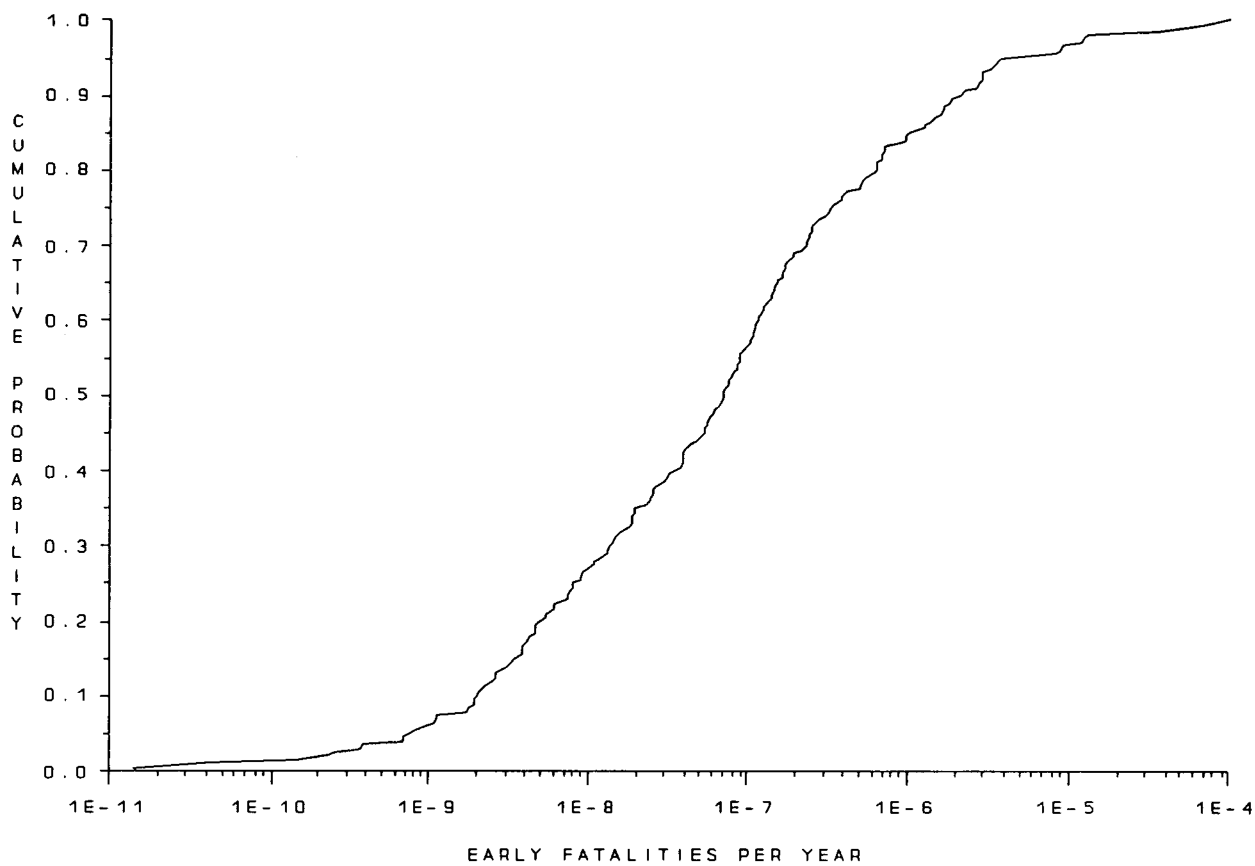

Figure 2. Empirical Distribution Function for Early Fatality Risk for Surry

Program Number 4: Plots of Empirical Distribution Functions. One of the most useful ways to display uncertainty results is through use of an empirical distribution function. The empirical distribution function provides estimates of various quantiles, as well as an estimate of the population cumulative distribution function. SAS has a procedure PROC GPLOT for which the input can be easily modified to produce a graph of an empirical distribution function. This program uses the SAS data set SURRY.SSD to produce an empirical distribution function for each consequence measure specified by the user. The graphs are scaled by using the maximum and minimum values obtained from Program Number 3 for each consequence measure. Figure 2 shows the output from this program for the consequence of early fatalities.

Program Number 5: Stepwise Regression. Regression results are very useful in the determination of which input variables in the LHS file are influencing a particular output such as consequences. This program uses the SAS data set SURRY.SSD to perform a stepwise regression analysis (Iman and Conover, 1989, Ref. 24) on each consequence specified by the user. Many times the model will have to be modified to transform variables, or to include dummy variables to account for various phenomena, or to account for nonlinearities. The modifications vary from one analysis to the next. This program was set up to perform a regression analysis for early fatalities at Surry due to steam generator tube ruptures.

Program Number 6: Scatterplots. A plot of a particular input variable in the LHS file versus a particular output variable, such as early fatalities, can be quite useful in providing information with respect to the relationship between these two variables. This plot can in turn lead to modifications to improve the regression model used in Program Number 5. This program uses the SAS data set SURRY.SSD to generate scatterplots of early fatalities at Surry versus any of the variables in the LHS.

Program Number 7: Sorting Accident Progression Bins. The last part of Section 3 contained a discussion of a situation where it is desired to select APBs that are not otherwise easily obtainable (if at all) for an analysis by use of record number 5 in the PRAMIS.INP file. This program reads in the APB file and deletes cases (APBs) that are not wanted, with the remaining case written to an ASCII output file. In Section 3 this file was referred to as OTHER.DAT and that is the same name used in this program.

Program Number 8: Graphs for Fractional Contributions. Section 4 discussed the use of PRAMIS to compute fractional contributions by two different methods. Method 1 creates a distribution of results that can be displayed in graphical form by using this FORTRAN program. This program generates a boxplot (Ref. 24) for each plant damage state for each consequence. The output from this program is shown in Figure 3 for early fatalities at Surry.

The following explanation is offered for those readers not familiar with boxplots. The endpoints of the box in Figure 3 are formed by the lower and upper quartiles of the data, that is $X_{.25}$ and $X_{.75}$. The vertical line within the box represents the median, $X_{.50}$. The sample mean is identified by the large dot. The bar on the right of the box extends to the minimum of $1.5(X_{.75} - X_{.25})$ and the maximum observation. In a similar manner, the bar on the left of the box extends to the maximum of $1.5(X_{.75} - X_{.25})$ and the minimum observation. The x's outside of these bars are useful to determine the degree of skewness. In symmetric distributions these values would be considered as outliers.

This program creates a file that is used by the MAPPER program to create plots as shown in Figure 3. MAPPER operates on DISPLAY commands, so if the user does not have access to the MAPPER PROGRAM then it may be necessary for the user to write their own display package by modifying this program. This program requires an input file called SUMMARY.DAT that contain four records. The first record contains the plant name enclosed in single quotes. The second record contains the name for the type of analysis enclosed in single quotes, such 'INTERNAL' or 'FIRE' or 'SEISMIC.' This name becomes part of the title on the plots. The third record contains the name of the FRC file (see page 16), that is, either 'SURRY.PDS' or 'SURRY.PAR,' depending on the type of analysis. The last record contains the integer 1 when the analysis is to be performed for PDS and the integer 2 when the analysis is to be performed for PAR.

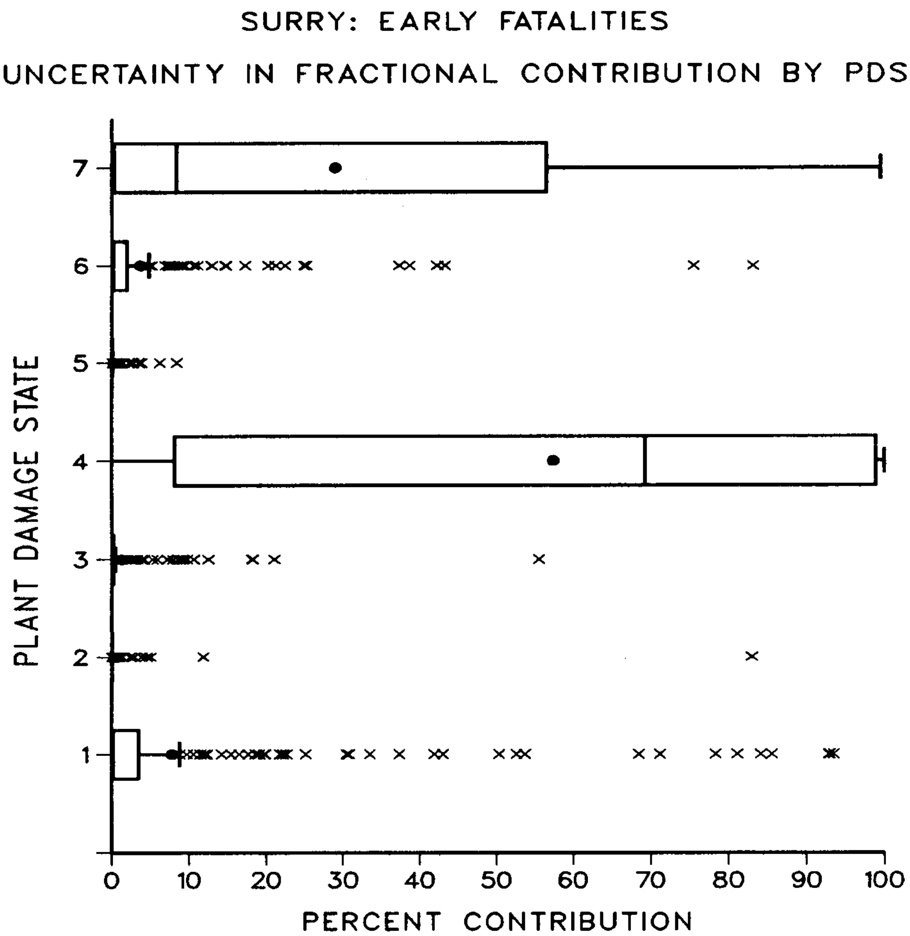

Figure 3. Boxplots for the Uncertainty in Fractional Contribution by PDS

REFERENCES

1. "Severe Accident Risks: An Assessment for Five U. S. Nuclear Power Plants (Draft for Comment)," NUREG-1150, U. S. Nuclear Regulatory Commission, Washington, D. C., 1989.

2. McKay, M. D., W. J. Conover, and R. J. Beckman, "A Comparison of Three Methods for Selecting Values of Input Variables in the Analysis of Output from a Computer Code," Technometrics, Vol. 21, pp. 239-245 (1979).

3. Iman, R. L. and Shortencarier, M. J. "A User's Guide for the Top Event Matrix Analysis Code (TEMAC)," NUREG/CR-4598, SAND86-0960, Sandia National Laboratories, Albuquerque, NM, 1986.

4. Iman, R. L., "A Matrix-Based Approach to Uncertainty and Sensitivity Analysis for Fault Trees," *Risk Analysis, 7*, pp. 21-33 (1987).

5. Griesmeyer, J. M. and Smith, L. N., "A Reference Manual for the Event Progression Analysis Code (EVNTRE)," NUREG/CR-5174, SAND88-1607, Sandia National Laboratories, Albuquerque, NM, 1989.

6. Jow, H.-N., Murfin, W. B., and Johnson, J. D., "XSOR Codes User's Manual," NUREG/CR-5360, SAND89-0943, Sandia National Laboratiories, Albuquerque, NM, 1989. (Draft copy available in NRC Public Document Room).

7. Chanin, D. I., Sprung, J. L., Ritchie, L. T., and Jow, H.-N. "MELCOR Accident Consequence Code System (MACCS), User's Guide," NUREG/CR-4691, Vol. I, SAND86-1562, Sandia National Laboratories, Albuquerque, NM, 1990.

8. Iman, R. L., Helton, J. C. and Johnson, J. D., "A User's Guide for PARTITION: A Program Defining the Source Term/Consequence Analysis Interface in the NUREG-1150 Probabilistic Risk Assessments," NUREG/CR-5253, SAND88-2940, Sandia National Laboratories, Albuquerque, NM, 1990.

9. Kaplan, S., "Matrix Theory Formalism for Event Tree Analysis: Application to Nuclear-Risk Analysis," Risk Analysis, Vol. 2, pp. 9-18 (1982).

10. Bley, D. C., S. Kaplan, and B. J. Garrick, "Assembling and Decomposing PRA Results: A Matrix Formalism," in Proceedings of the International Meeting on Thermal Nuclear Reactor Safety, NUREG/CP-0027, Vol. 1, pp. 173-182, U.S. Nuclear Regulatory Commission, Washington, D.C., 1983.

11. Worrell, R. B., "SETS Reference Manual," NUREG/CR-4213, SAND83- 2675, Sandia National Laboratories, Albuquerque, NM, 1985.

12. Bertucio, R. C., Quilici, M. D., Young, J. and Harper, F. T., "Analysis of Core Damage Frequency from Internal Events: Surry, Unit 1," NUREG/CR-4550, Vol. 3, SAND86-2084, Sandia National Laboratories, Albuquerque, NM, 1986.

13. Bertucio, R. C., Moore, D. L., Held, J. T., Leahy, T. J., Harper, F. T. and Camp, A. L., "Analysis of Core Damage Frequency from Internal Events: Sequoyah, Unit 1," NUREG/CR-4550, Vol. 5, SAND86-2084, Sandia National Laboratories, Albuquerque, NM, 1987.

14. Kolaczkowski, A. M., Lambright, J. A., Ferrell, W. L., Cathey, N. G., Najifi, B. and Harper, F. T., "Analysis of Core Damage Frequency from Internal Events: Peach Bottom, Unit 2," NUREG/CR-4550, Vol. 4, SAND86-2084, Sandia National Laboratories, Albuquerque, NM, 1987.

15. Drouin, M. T., LaChance, J. L., Shapiro, B. J., Harper, F. T. and Wheeler, T. A., "Analysis of Core Damage Frequency from Internal Events: Grand Gulf, Unit 1," NUREG/CR-4550, Vol. 6, SAND86-2084, Sandia National Laboratories, Albuquerque, NM, 1987.

16. Wheeler, T. A., "Analysis of Core Damage Frequency from Internal Events: Zion, Unit 1," NUREG/CR-4550, Vol. 7, SAND86-2084, Sandia National Laboratories, Albuquerque, NM, 1986.

17. Benjamin, A. S., Behr, V. L., Kunsman, D. M. and Murfin, W. B., "Containment Event Analysis for Postulated Severe Accidents: Surry Power Station, Unit 1 (Draft for Comment)," NUREG/CR-4700, SAND86-1135, Vol. 1, Sandia National Laboratories, Albuquerque, NM, 1987.

18. Behr, V. L., Benjamin, A. S., Kunsman, D. M., Lewis, S. R. and Murfin, W. B., "Containment Event Analysis for Postulated Severe Accidents: Sequoyah Power Station, Unit 1 (Draft for Comment)," NUREG/CR-4700, SAND86-1135, Vol. 2, Sandia National Laboratories, Albuquerque, NM, 1987.

19. Amos, C. N., Griesmeyer, J. M., and Kolaczkowski, A. M., "Containment Event Analysis for Postulated Severe Accidents: Peach Bottom Atomic Power Station, Unit 2 (Draft for Comment)," NUREG/CR-4700, SAND86-1135, Vol. 3, Sandia National Laboratories, Albuquerque, NM, 1987.

20. Amos, C. N. and Kolaczkowski, A. M., "Containment Event Analysis for Postulated Severe Accidents: Grand Gulf Nuclear Station, Unit 1 (Draft for Comment)," NUREG/CR-4700, SAND86- 1135, Vol. 4, Sandia National Laboratories, Albuquerque, NM, 1987.

21. Denning, R. S., Gieseke, J. A., Cybulskis, P., Lee, K. W., Jordan, H., Curtis, L. A., Kelly, R. F., Kogan, V. and Schumacher, P. M., "Radionuclide Calculations for Selected Severe Accident Scenarios," NUREG/CR-4624, BMI-2139, Vols. 1- 5, Battelle's Columbus Division, Columbus, OH, 1986.

22. Hora, S. C. and Iman, R. L., "Expert Opinion in Risk Analysis - The NUREG-1150 Methodology," *Nuclear Science and Engineering*. 1989.

23. Iman, R. L. and M. J. Shortencarier, "A FORTRAN 77 Program and User's Guide for the Generation of Latin Hypercube and Random Samples for Use with Computer Models," NUREG/CR-3624, SAND83-2365, Sandia National Laboratories, Albuquerque, NM, 1984.

24. Iman, R. L. and Conover, W. J., **Modern Business Statistics**, 2nd ed, Wiley, New York, 1989.

APPENDIX A

PROGRAMS USED TO PROCESS THE OUTPUT FROM PRAMIS

1. CREATING A SAS DATA SET
2. SUMMARY STATISTICS
3. MAXIMUM AND MIMIMUM VALUES
4. PLOTS OF EMPIRICAL DISTRIBUTION FUNCTIONS
5. STEPWISE REGRESSION
6. SCATTERPLOTS
7. SORTING ACCIDENT PROGRESSION BINS
8. BOXPLOTS FOR DISPLAYING UNCERTAINTY IN FRACTIONAL CONTRIBUTIONS

PROGRAM NUMBER 1: CREATING A SAS DATA SET

```
*
* A SAS PROGRAM TO CREATE A SAS DATA SET FROM THE *.REG OUTPUT FILE
* CREATED BY PRAMIS.  LABELS ARE ASSIGNED TO THOSE VARIABLES THAT
* ARE KEPT IN DATA SET FOR SUBSEQUENT ANALYSES
*
* THE SAS DATA SET CREATED BY THIS PROGRAM IS NAMED "SURRY.SSD"
*;
OPTIONS LS=79;
FILENAME SURRY '[RLIMAN.PRAMIS]SURRY.REG';
LIBNAME STORAGE'[RLIMAN.PRAMIS]';
*
* INPUT THE *.REG FILE CREATED BY PRAMIS AND ASSIGN LABELS
*;
DATA STORAGE.SURRY;
 INFILE SURRY;
 INPUT I1 I2 X1-X161 S2C1-S2C9;
LABEL  X1   =' 1 -DIESEL GEN FAILS TO RUN FOR 1HR'
       X3   =' 3 -DIESEL GEN FAILS TO START'
       X4   =' 4 -ABSENCE FAV MODERATOR TEMP COEFF'
       X5   =' 5 -INTERFACING SYSTEMS LOCA'
       X6   =' 6 -LOSS OF OFF-SITE POWER'
       X7   =' 7 -NO SIGNAL FROM SIS ACT TRIAN X'
       X8   =' 8 -COMMON CAUSE FACTOR FOR 2 MOVS'
       X9   =' 9 -CCF OF AFW FROM STEAM LEAK THRU CKVS'
       X10  ='10 -MOTOR DRIVEN PUMP FAILS TO START'
       X11  ='11 -PORV PLOCK VALVE FAILS TO OPEN'
       X12  ='12 -LPR MOV FAILS TO TRANSFER'
       X13  ='13 -MOV FAILS TO TRANSFER'
       X14  ='14 -FLOW DIVER TO UNIT 2 VIA X-CONNECT'
       X15  ='15 -SOV FAILS TO TRANSFER'
       X16  ='16 -FAILURE TO ESTABLISH F&B'
       X17  ='17 -OP FAILS TO X-CONNECT UNIT 2 CST'
       X18  ='18 -FAIL TO X-CONNECT AFW W/UNIT 2'
       X19  ='19 -LARGE LOCA'
       X20  ='20 -MEDIUM LOCA'
       X21  ='21 -COMBINED FREQ ALL INITIAT - ATWS'
       X22  ='22 -COMBINED FREQ HI PWR INIT - ATWS'
       X23  ='23 -LOSS OF MFWS'
       X24  ='24 -STEAM GENERATOR TUBE RUPTURE'
       X25  ='25 -FAILURE OF RPS TO SCRAM RX'
       X26  ='26 -AUX BLDG - FIRE AREA RATIO'
       X27  ='27 -AUX BLDG - FIRE SEVERITY RATIO'
       X28  ='28 -AUX BLDG - FAIL TO SUPPRESS FIRE'
       X29  ='29 -AUX BLDG - FAIL RESTORE HPI UNIT 2'
       X30  ='30 -CVT RM - FIRE AREA RATIO'
       X31  ='31 -CVT RM - FIRE SEVERITY RATIO'
       X32  ='32 -CVT RM - FAIL TO SUPPRESS FIRE'
       X33  ='33 -CVT RM - FAIL OF CO-2 SYSTEM'
       X34  ='34 -CVT RM - FAIL RESTORE HPI UNIT 2'
       X35  ='35 -CON RM - CABINET AREA RATIO'
       X36  ='36 -CON RM - FAIL RESTORE HPI UNIT 2'
       X37  ='37 -EMSWG RM - FAIL TO SUPPRESS FIRE'
       X38  ='38 -EMSWG RM-FIRE AREA RATIO SMALL FIRES'
```

```
X39  ='39 -EMSWG RM-FIRE SEVERITY RAT SML FIRES'
X40  ='40 -EMSWG RM-FIRE AREA RATIO LARGE FIRES'
X41  ='41 -EMSWG RM-FIRE SEVERITY RAT LG FIRES'
X42  ='42 -CPSWP RM - FAIL TO SUPPRESS FIRE'
X43  ='43 -DUMMY'
X44  ='44 -SG/RCS PORV FAILS TO RECLOSE'
X45  ='45 -OP FAILS TO RESTORE ACT FAILURE'
X46  ='46 -AC/DC BUSWORK FAILURE'
X47  ='47 -CONTROL ROOM FIRE'
X48  ='48 -AUXILIARY BLDG.'
X49  ='49 -ELECTRICAL SWITCHGEAR ROOM'
X50  ='50 -CABLE VAULT AND TUNNEL'
X51  ='51 -CHRG PUMP SVC WATER PUMP ROOM'
X52  ='52 -STUCK OPEN SECONDARY SRV W/SBO'
X53  ='53 -STUCK OPEN SEC SRV W/SBO UNIT 2'
X54  ='54 -FAILURE TO MANUALLY SCRAM RX'
X55  ='55 -COMMON CAUSE FACTOR FOR 2 AFW MDPS'
X56  ='56 -COMMON CAUSE FACTOR FOR 2 LPI PUMPS'
X57  ='57 -FAIL OF RMTS BY MISCALIBRATION'
X58  ='58 -CHECK VALVE FAILS TO OPEN'
X59  ='59 -AFW MDP FAILS TO START'
X60  ='60 -MOV PLUGGED -12 MO TEST PERIOD'
X61  ='61 -MOV PLUGGED -3 MO TEST PERIOD'
X62  ='62 -TDP FAILS TO RUN FOR 6 HR'
X63  ='63 -TDP FAILS TO RUN FOR 24 HR'
X64  ='64 -TDP FAILS TO START'
X65  ='65 -OP FAILS TO OPEN PORVS'
X66  ='66 -MANUAL VLV PLUG - 1 MO TEST'
X67  ='67 -SMALL LOCA'
X68  ='68 -VERY SMALL LOCA'
X69  ='69 -LOSS OF A DC BUS INITIATOR'
X70  ='70 -Q14    V BREAK UNDER WATER'
X71  ='71 -Q16C1  PORVS STICK OPEN'
X72  ='72 -Q17C2  RCP SEAL FAILURE'
X78  ='78 -Q19C1  T-I SGTR'
X79  ='79 -Q20C1  T-I Hot Leg & Fr.Zr Ox.In-Ves'
X81  ='81 -Q23C2  RCS PRESSURE AT VB'
X86  ='86 -Q24C5  CORE DAMAGE ARREST'
X96  ='96 -Q33    Fraction Core in HPME'
X97  ='97 -Q35C1  ALPHA MODE VB'
X99  ='99 -Q36C2  TYPE OF VB'
X100 ='100-Q36C2  TYPE OF VB'
X105 ='105-Q38C1  SIZE OF HOLE in Vessel'
X107 ='107-Q39C3  deltaP at VB, Lo Pr'
X108 ='108-Q39C5  deltaP at VB, not Lo Pr'
X126 ='126-Q42P6    CONT. FAILURE PRESSURE.'
X127 ='127-Q42P7 Ran.Num. FOR FAIL. MODE'
X128 ='128-Q50P10 Burn SCALE FACTOR - SPRAY'
X129 ='129-Q62P14 Burn SCALE FACTOR - NOSPRAY'
X130 ='130-ST1 - FCOR - Rel. from Core'
X131 ='131-ST2 - FVES - Rel. from Vessel'
X132 ='132-ST3 - VDF - DF for Event V'
X133 ='133-ST4 - FCONV - RCS Rel. from Cont.'
X134 ='134-ST5 - FCCI - Rel. from CCI'
X135 ='135-ST6 - FCONC - CCI Rel. from Cont.'
```

```
       X136 ='136-ST7 - SPRDF - SPRAY DF'
       X137 ='137-ST8 - XLATE - Late Iodine'
       X138 ='138-ST9 - FLATE - Late Revol.'
       X139 ='139-ST10 - FDCH - DCH Release'
       X140 ='140-ST11 - FISG & FOSG - SGTR REL.'
       X141 ='141-ST12 - POOL SCRUBBING OF CCI'
       X142 ='142-Q21,Q45,Q56-Elec. Power Recovery'
       X154 ='154-RCP-LOCA-750-90M'
       X155 ='155-RCP-LOCA-467-150'
       X156 ='156-RCP-LOCA-183-150'
       X157 ='157-RCP-LOCA-183-210'
       X158 ='158-RCP-LOCA-1440-90'
       X159 ='159-RCP-LOCA-183-90'
       X160 ='160-RCP-LOCA-561-150'
       S2C1 ='EARLY FATALITIES'
       S2C2 ='EARLY INJURIES'
       S2C3 ='EARLY FATALITY RISK, 1 MILE'
       S2C4 ='TOTAL LATENT CANCER FATALITIES'
       S2C5 ='POPULATION DOSE WITHIN 50 MILES'
       S2C6 ='POPULATION DOSE WITHIN 1000 MILES'
       S2C7 ='TOTAL ECONOMIC COST'
       S2C8 ='EARLY FATALITY RISK, 0-1 MILE'
       S2C9 ='TOTAL LATENT CANCER RISK 0-10 MILES';
*
* DROP THOSE VARIABLES THAT WILL NOT BE USED IN ANY SUBSEQUENT
* ANALYSES
*;
DROP X2   X73  X74  X75  X76  X77  X80  X82  X83  X84  X85  X87
X88  X89  X90  X91  X92  X93  X94  X95  X98
X101 X102 X103 X104 X106 X109 X110 X111 X112 X113 X114 X115 X116
X117 X118 X119 X120 X121 X122 X123 X124 X125 X143 X144 X145 X146
X147 X148 X149 X150 X151 X152 X153 X161;
```

PROGRAM NUMBER 2: SUMMARY STATISTICS

```
* SAS PROGRAM TO COMPUTE SUMMARY STATISTICS FOR
* CONSEQUENCES FROM THE SAS DATA SET "SURRY1.SSD"
*;
OPTIONS LS=79;
*
* RETRIEVE THE SAS DATA SET
*;
LIBNAME STORAGE '[RLIMAN.PRAMIS]';
DATA STAT;
  SET STORAGE.SURRY1;
*
* COMPUTE THE SUMMARY STATISTICS FOR EARLY FATALITIES
*;
PROC UNIVARIATE;
  TITLE 'SUMMARY STATISTICS FOR SURRY - EARLY FATALITIES';
  VAR C1;
```

PROGRAM NUMBER 3: MAXIMUM AND MINIMUM VALUES

```
* SAS PROGRAM TO FIND MAXIMUM AND MINIMUM VALUES FOR
* CONSEQUENCES FROM THE SAS DATA SET "SURRY1.SSD"
*
*;
OPTIONS LS=64;
LIBNAME STORAGE '[RLIMAN.PRAMIS]';
DATA PROB;
  SET STORAGE.SURRY1;
  KEEP C1-C9;
PROC MEANS MIN MAX NOPRINT DATA=PROB;
  VAR C1;
  OUTPUT OUT=TEMP1 MIN=CMIN1 MAX=CMAX1;
PROC MEANS MIN MAX NOPRINT DATA=PROB;
  VAR C2;
  OUTPUT OUT=TEMP2 MIN=CMIN2 MAX=CMAX2;
PROC MEANS MIN MAX NOPRINT DATA=PROB;
  VAR C3;
  OUTPUT OUT=TEMP3 MIN=CMIN3 MAX=CMAX3;
PROC MEANS MIN MAX NOPRINT DATA=PROB;
  VAR C4;
  OUTPUT OUT=TEMP4 MIN=CMIN4 MAX=CMAX4;
PROC MEANS MIN MAX NOPRINT DATA=PROB;
  VAR C5;
  OUTPUT OUT=TEMP5 MIN=CMIN5 MAX=CMAX5;
PROC MEANS MIN MAX NOPRINT DATA=PROB;
  VAR C6;
  OUTPUT OUT=TEMP6 MIN=CMIN6 MAX=CMAX6;
PROC MEANS MIN MAX NOPRINT DATA=PROB;
  VAR C7;
  OUTPUT OUT=TEMP7 MIN=CMIN7 MAX=CMAX7;
PROC MEANS MIN MAX NOPRINT DATA=PROB;
  VAR C8;
  OUTPUT OUT=TEMP8 MIN=CMIN8 MAX=CMAX8;
PROC MEANS MIN MAX NOPRINT DATA=PROB;
  VAR C9;
  OUTPUT OUT=TEMP9 MIN=CMIN9 MAX=CMAX9;
DATA ALL;
  MERGE TEMP1 TEMP2 TEMP3 TEMP4 TEMP5 TEMP6 TEMP7 TEMP8 TEMP9;
PROC PRINT NOOBS DATA=ALL;
  TITLE 'MINIMUM AND MAXIMUM CONSEQUENCES FOR SURRY';
  FORMAT CMIN1 E9.4 CMAX1 E9.4
         CMIN2 E9.4 CMAX2 E9.4
         CMIN3 E9.4 CMAX3 E9.4
         CMIN4 E9.4 CMAX4 E9.4
         CMIN5 E9.4 CMAX5 E9.4
         CMIN6 E9.4 CMAX6 E9.4
         CMIN7 E9.4 CMAX7 E9.4
         CMIN8 E9.4 CMAX8 E9.4
         CMIN9 E9.4 CMAX9 E9.4;
```

PROGRAM NUMBER 4: PLOTS OF EMPIRICAL DISTRIBUTION FUNCTIONS

```
*SAS PROGRAM TO GENERATE PLOTS OF EMPIRICAL DISTRIBUTION FUNCTIONS
*
*THE FIRST SET OF COMMANDS WILL VARY DEPENDING ON THE TYPE OF HARDWARE
*AVAILABLE FOR PLOTTING AT A PARTICULAR SITE;
*
*FILENAME SASPLT 'SAS.PLT';
*GOPTIONS
  AUTOFEED
  DEVICE = TEK4014
  NODISPLAY
  NOCELL
  NOCHARACTERS
  GSFLEN = 79
  GSFMODE = APPEND
  GSFNAME = SASPLT
  HANDSHAKE = XONXOFF
  NOPROMPT ;
*
*OPTION FOR DISPLAYING OUTPUT ON A SCREEN
*;
OPTIONS LS=79 DEVICE=TEK4105;
*
* INPUT AND SORT THE DATA FOR A SAMPLE OF SIZE 200 FROM THE
* SAS DATA SET STORED IN [RLIMAN.PRAMIS] AS "SURRY1.SSD"
*;
LIBNAME STORAGE '[RLIMAN.PRAMIS]';
DATA PROB;
  SET STORAGE.SURRY1;
  PROB = _N_/200;
  KEEP PROB;
DATA DATA1(KEEP=C1) DATA2(KEEP=C2) DATA3(KEEP=C3)
     DATA4(KEEP=C4) DATA5(KEEP=C5) DATA6(KEEP=C6)
     DATA7(KEEP=C7) DATA8(KEEP=C8) DATA9(KEEP=C9);
  SET STORAGE.SAMPLE1;
PROC SORT DATA=DATA1;
  BY C1;
PROC SORT DATA=DATA2;
  BY C2;
PROC SORT DATA=DATA3;
  BY C3;
PROC SORT DATA=DATA4;
  BY C4;
PROC SORT DATA=DATA5;
  BY C5;
PROC SORT DATA=DATA6;
  BY C6;
PROC SORT DATA=DATA7;
  BY C7;
PROC SORT DATA=DATA8;
  BY C8;
PROC SORT DATA=DATA9;
  BY C9;
DATA ALL;
```

```
  MERGE PROB DATA1 DATA2 DATA3
             DATA4 DATA5 DATA6
             DATA7 DATA8 DATA9;
*
* PLOT THE EDF FOR EARLY FATALITIES
*;
PROC GPLOT;
  TITLE H=1.5 ' ';
    AXIS1 OFFSET = (0)
      VALUE=(H=1 '1E-11' '1E-10' '1E-9' '1E-8'
                 '1E-7' '1E-6' '1E-5' '1E-4')
      LABEL=(H=1 'EARLY FATALITIES PER YEAR')
      LOGBASE = 10;
  AXIS2 OFFSET = (0)
    LABEL = (A=-90 R=90 H=1 'CUMULATIVE PROBABILITY')
    VALUE = (H=1)
    ORDER = (0 TO 1 BY .1);
  PLOT PROB*C1 / HAXIS=AXIS1 VAXIS=AXIS2;
    SYMBOL1 I=J L=1 V=NONE;
```

PROGRAM NUMBER 5: STEPWISE REGRESSION

```
* SAS PROGRAM TO PERFORM A STEPWISE REGRESSION ANALYSIS
* FOR THE SASDATA SET "SURRY1.SSD"
*;
OPTIONS LS=79;
LIBNAME STORAGE '[RLIMAN.PRAMIS]';
*
* READ IN THE DATA FILE AND TRANSFORM THE CONSEQUENCE
* MEASURE TO LOGS - SET ZERO VALUES EQUAL TO THE MINIMUM
* NONZERO VALUE CALCULATED FOR THE CONSEQUENCE
*;
DATA REG;
  SET STORAGE.SURRY1;
  IF C1 = 0 THEN C1 = 1E-14;
  C1 = LOG10(C1);
*
* REGRESSION ANALYSIS FOR EARLY FATALITIES
*;
PROC STEPWISE DATA=REG;
  MODEL C1 = X1 X3-X72 X78-X79 X81 X86 X96 X97 X99 X100 X105 X107-X108
             X126-X142 X154-X160 /FORWARD SLE=.01 SLS=.05;
  TITLE 'SURRY: EARLY FATALITIES';
  TITLE2 'CONDITIONAL ON SGTR';
```

PROGRAM NUMBER 6: SCATTERPLOTS

```
* SAS PROGRAM TO GENERATE SCATTERPLOTS OF SELECTED LHS VARIABLES
* VERSUS SELECTED CONSEQUENCES FROM THE SAS DATA SET "SURRY1.SSD"
*
* THE FIRST GROUP OF STATEMENTS PROVIDE SPECS FOR THE CREATION OF
* A FILE NAMED "SAS.PLT" THAT WILL HAVE TO BE OUTPUT TO THE SPECIFIED
* DEVICE.  THESE STATEMENTS WILL HAVE TO BE MODIFIED TO CORRESPOND TO
* THE HARDWARE AT A PATICULAR SITE
*;
*FILENAME SASPLT 'SAS.PLT';
*GOPTIONS
  AUTOFEED
  DEVICE = QMS2400
  HPOS = 150
  VPOS = 50
  NODISPLAY
  NOCELL
  NOCHARACTERS
  GSFLEN = 79
  GSFMODE = APPEND
  GSFNAME = SASPLT
  HANDSHAKE = XONXOFF
  NOPROMPT ;
*
* THIS OPTION ALLOWS THE PLOT TO APPEAR ON A MONITOR SCREEN
*;
OPTIONS LS=79 DEVICE=TEK4105;
*
* READ IN THE SAS DATA SET
*;
LIBNAME STORAGE '[RLIMAN.PRAMIS.SURRY]';
DATA PROB;
  SET STORAGE.SURRY1;
*
* MAKE THE SCATTERPLOTS FOR EARLY FATALITIES VERSUS
* VARIABLES X1 AND X5 IN THE LHS FILE
*;
PROC GPLOT;
  TITLE 'SURRY: EARLY FATALITIES';
  AXIS1 OFFSET = (0)
    VALUE = (H=1.5 '1E-13' '1E-12' '1E-11' '1E-10' '1E-9' '1E-8'
             '1E-7' '1E-6' '1E-5' '1E-4')
    LABEL = (H=1.5)
    LOGBASE = 10;
  AXIS2 OFFSET = (0)
    VALUE=(H=1.5 '1E-9' '1E-8' '1E-7' '1E-6' '1E-5' '1E-4'
           '1E-3' '1E-2')
    LABEL=(A=-90 R=90 H=1.5 'EARLY FATALITIES PER YEAR')
    LOGBASE = 10;
  PLOT C1*X1/HAXIS=AXIS1 VAXIS=AXIS2;
    SYMBOL1 I=NONE V=0;
PROC GPLOT;
  TITLE 'SURRY: EARLY FATALITIES';
  AXIS1 OFFSET = (0)
```

```
    VALUE = (H=1.5 '1E-13' '1E-12' '1E-11' '1E-10' '1E-9' '1E-8'
             '1E-7' '1E-6' '1E-5' '1E-4')
    LABEL = (H=1.5)
    LOGBASE = 10;
  AXIS2 OFFSET = (0)
    VALUE=(H=1.5 '1E-9' '1E-8' '1E-7' '1E-6' '1E-5' '1E-4'
           '1E-3' '1E-2')
    LABEL=(A=-90 R=90 H=1.5 'EARLY FATALITIES PER YEAR')
    LOGBASE = 10;
  PLOT C1*X5/HAXIS=AXIS1 VAXIS=AXIS2;
    SYMBOL1 I=NONE V=0;
```

PROGRAM NUMBER 7: SORTING ACCIDENT PROGRESSION BINS

```
* SAS PROGRAM TO DELETE SELECTED ACCIDENT PROGRESSION BINS
* CONTAINED IN THE MASTER BIN LIST FILE "MBL.DAT" (AN ASCII FILE)
*
* IT WILL PROBABLY BE NECESSARY TO EDIT THIS FILE BY DELETING THE
* FIRST TWO RECORDS BEFORE RUNNING THIS SAS PROGRAM AS THE FILE
* SHOULD CONTAIN ONLY THE 11-CHARACTER DESCRIPTORS FOR EACH
* ACCIDENT PROGRESSION BIN
*
* THE SET OF STATEMENTS BELOW DELETES THOSE APBs WITH
* THE FOLLOWING CHARACTERISTICS:
*
*      1CDEFG .AND. 5D .AND. 6C
*
*      1CD .AND. 4ABC .AND. 5ACE .AND. 6C
*
*      1EF .AND. 5ABC .AND. 6C
*
*      1AB .OR. 6AB
*
*      1G .AND. 5ABC .AND. 6C .AND. 10D
*
*      1CDEFG .AND. 5F .AND. 6C
*
* ALL OF THE REMAINING APBs ARE STORED IN AN ASCII FILE
* NAMED "OTHER.DAT,' WHICH WILL HAVE TO BE EDITED TO REMOVE
* ALL OF THE BLANKS BETWEEN THE CHARACTER DESCRIPTORS,
* SINCE THE ASCII FILE IS WRITTEN WITH A BLANK BETWEEN EACH
* PAIR OF CHARACTERS
*;
OPTIONS LINESIZE=78;
DATA DATA1;
 INFILE MBL;
 INPUT ATT1 $ 1 ATT2 $ 2 ATT3 $ 3 ATT4 $ 4 ATT5 $ 5 ATT6 $ 6
       ATT7 $ 7 ATT8 $ 8 ATT9 $ 9 ATT10 $ 10 ATT11 $ 11;
 IF (( ATT1 = 'C' OR ATT1 = 'D' OR ATT1 = 'E' OR ATT1 = 'F' OR ATT1 = 'G')
     AND
        (ATT5 = 'D')
     AND
        (ATT6 = 'C'))
 THEN DELETE;
```

```
ELSE
IF (( ATT1 = 'C' OR ATT1 = 'D')
    AND
       (ATT4 = 'A' OR ATT4 = 'B' OR ATT4 = 'C')
    AND
       (ATT5 = 'A' OR ATT5 = 'C' OR ATT5 = 'E')
    AND
       (ATT6 = 'C'))
THEN DELETE;
ELSE
IF (( ATT1 = 'E' OR ATT1 = 'F')
    AND
       (ATT5 = 'A' OR ATT5 = 'B' OR ATT5 = 'C')
    AND
       (ATT6 = 'C'))
THEN DELETE;
ELSE
IF (( ATT1 = 'A' OR ATT1 = 'B')
    OR
       (ATT6 = 'A' OR ATT6 = 'B'))
THEN DELETE;
ELSE
IF (( ATT1 = 'G')
    AND
       (ATT5 = 'A' OR ATT5 = 'B' OR ATT5 = 'C')
    AND
       (ATT6 = 'C')
    AND
       (ATT10 = 'D'))
THEN DELETE;
ELSE
IF (( ATT1 = 'C' OR ATT1 = 'D' OR ATT1 = 'E' OR ATT1 = 'F' OR ATT1 = 'G')
    AND
       (ATT5 = 'F')
    AND
       (ATT6 = 'C'))
THEN DELETE;
FILE OTHER;
  PUT ATT1-ATT11;
```

PROGRAM NUMBER 8: BOXPLOTS FOR DISPLAYING UNCERTAINTY IN FRACTIONAL CONTRIBUTIONS

```
      PROGRAM BOXPLOT
C<><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
C
C   PROGRAMMER:  Ginger Wilkinson
C
C   PURPOSE:  Creates MAPPER instructions for boxplots, mean plots
C             and median plots of fraction contribution by plant
C             damage states
C
C   MAXN = MAXIMUM NUMBER OF OBSERVATIONS
C   MAXPDS = MAXIMUM NUMBER OF PLANT DAMAGE STATES
C   MAXCSQ = MAXIMUM NUMBER OF CONSEQUENCE MEASURES
C
C<><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><><>
C
      PARAMETER(MAXPDS=80,MAXN=250,MAXCSQ=10)
      COMMON /XARRAY/ X(MAXN,MAXCSQ*MAXPDS), KCONSQ(MAXCSQ),
     $                KPDS(MAXPDS), NPDS, NCONSQ, NV, N, INFILE
      DIMENSION TEMP(MAXN)
      DIMENSION XBIG(MAXCSQ)
      DIMENSION PDSBIG(MAXCSQ*MAXPDS)
      DIMENSION WORK(MAXN)
      DIMENSION KASES(MAXCSQ)
      DIMENSION DUM(MAXN)
C
      CHARACTER*15 PLANT
      CHARACTER*10 INFILE
      CHARACTER*18 YLABEL
      CHARACTER*37 TITLE1
      CHARACTER*38 TITLE2
      CHARACTER*10 TYPE
      CHARACTER*62 HEADER
C
      OPEN(UNIT=1,FILE='SUMMARY.DAT',STATUS='OLD')
      OPEN(UNIT=50,FILE='BOX.MAP',STATUS='NEW')
      OPEN(UNIT=51,FILE='MEAN.MAP',STATUS='NEW')
      OPEN(UNIT=52,FILE='MEDIAN.MAP',STATUS='NEW')
      OPEN(UNIT=53,FILE='STATS.DAT',STATUS='NEW')
C
C...NOTE:  temporary file written to unit 49 later in the program!!
C
C...Read in summary data
C
      READ(1,*) PLANT
      READ(1,*) TYPE
      READ(1,*) INFILE
      READ(1,*) IFLAG
C
      IF (IFLAG.EQ.1) THEN
         YLABEL = 'PLANT DAMAGE STATE'
      ELSE
         IF (IFLAG.EQ.2) YLABEL = 'PARTITION GROUP
      ENDIF
```

```
C
      CALL FRACON
C
C...Convert to percentages
C
      DO 990 II=1,N
          DO 991 JJ=1,NV
              X(II,JJ) = X(II,JJ) * 100.
  991     CONTINUE
  990 CONTINUE
C
C
C...Sort columns and determine largest value
C
      DO 30 J=1,NCONSQ
         XBARMX = 0.0
         X50MAX = 0.0
C
C...XBIG(J) = maximum value in the X matrix FOR EACH CONSEQUENCE
C
         DO 35 K = (J-1)*NPDS + 1, J*NPDS
            PDSBIG(K) = 0.
            NUM = 0
            DO 73 ILOOP=1,MAXN
               DUM(ILOOP) = 0
   73       CONTINUE
C
              DO 38 II=1,N
                 IF (X(II,K).LT.900) THEN
                    NUM = NUM + 1
                    DUM(NUM) = X(II,K)
                 ENDIF
   38         CONTINUE
            CALL SIFT(N,X(1,K))
            IF (NUM.GT.0) CALL SIFT(NUM,DUM(1))
            PDSBIG(K) = MAX(PDSBIG(K),DUM(NUM))
   35    CONTINUE

         XBIG(J) = PDSBIG((J-1)*NPDS + 1)
C
C...Largest x value in current consequence
C
         DO 36 ITEMP = 1,NPDS
            XBIG(J) = MAX(XBIG(J),PDSBIG(((J-1)*NPDS + 1) + (ITEMP-1)))
  36     CONTINUE


   30 CONTINUE
C
C...Statistics
C
      WRITE(53,9000) PLANT, TYPE
 9000 FORMAT(1X,A / 1X,A / ' ********' //)
      WRITE(53,9001)
 9001 FORMAT(T5,'CONSEQUENCE',T25,'PDS',T45,'MEAN',T64,'MEDIAN' /
```

```
     $        T5,'***********',T25,'***',T45,'****',T64,'******' //)
C
C...Loop for each of the NCONSQ consequences
C
      DO 5 LOOP1 = 1,NCONSQ
      ICON=KCONSQ(LOOP1)
      KASES(LOOP1) = 0
C
C...Process each plant damage state
C
      DO 40 LOOP2=1,NPDS
C
      NRISK = 0
         DO 6 IJ=1,N
           WORK(IJ) = 0.
    6    CONTINUE
C
C......LOOP2 is current plant damage state number
C......JPDS is the j-index of the X array
C

         JPDS = (LOOP1-1) * NPDS + LOOP2
C
C......count number of KASES with risk and write to work array
C
         DO 23 I=1,N
            IF (X(I,JPDS).LT.900) THEN
               NRISK = NRISK + 1
               WORK(NRISK) = X(I,JPDS)
            ENDIF
   23    CONTINUE
C
C......determine .25, .5, and .75 quantiles
C
         IF(MOD(NRISK,4).EQ.0) THEN
            I25 = NRISK/4
            J25 = I25 + 1
         ELSE
            I25 = NRISK/4 + 1
            J25 = I25
         ENDIF
         X25 =(WORK(I25) + WORK(J25)) / 2
C
         IF(MOD(NRISK,2).EQ.0)THEN
            I50 = NRISK/2
            J50 = I50 + 1
         ELSE
            I50 = NRISK/2 + 1
            J50 = I50
         ENDIF
         X50 = (WORK(I50) + WORK(J50)) / 2
         IF (X50MAX.LT.X50) X50MAX = X50
C
         I75 = NRISK - I25 + 1
         J75 = NRISK - J25 + 1
```

```
         X75 = (WORK(I75) + WORK(J75)) / 2
C
         XIQR = X75 - X25
         XMAX = WORK(NRISK)
         XMIN = WORK(1)
         A = X75 + 1.5 * XIQR
         B = X25 - 1.5 * XIQR
         PTMAX = MIN(XMAX,A)
         PTMIN = MAX(XMIN,B)
         XCENT = X25 + XIQR/2
C
C......determine number of y-values per page
C
      IF (NPDS.LE.20) THEN
         NYVAL = NPDS
         NPAGE = 1
      ELSE
         IF (NPDS.LE.40) THEN
            NYVAL = NPDS / 2
            LASTPG = NPDS - NYVAL
            NPAGE = 2
         ELSE
            IF (NPDS.LE.60) THEN
               NYVAL = NPDS / 3
               LASTPG = NPDS - (NYVAL * 2)
               NPAGE = 3
            ELSE
               IF (NPDS.LE.80) THEN
                  NYVAL = NPDS / 4
                  LASTPG = NPDS - (NYVAL * 3)
                  NPAGE = 4
               ENDIF
            ENDIF
         ENDIF
      ENDIF
C
C......size height of box and endline based on # of pds
C
         IF (NPDS.GT.5) THEN
            Y1 = FLOAT(LOOP2) - .125
            Y2 = FLOAT(LOOP2) + .125
            YLEN = .5
            YMED1 = LOOP2 - .25
            YMED2 = LOOP2 + .25
         ELSE
            Y1 = FLOAT(LOOP2) - .0625
            Y2 = FLOAT(LOOP2) + .0625
            YLEN = .25
            YMED1 = LOOP2 - .125
            YMED2 = LOOP2 + .125
         ENDIF
C
C......compute the mean
C
      SUM = 0.
```

```
      DO 45 I = 1,NRISK
      SUM = SUM + WORK(I)
   45 CONTINUE
C
C
      XBAR = SUM/FLOAT(NRISK)
      IF(XBARMX.LT.XBAR) XBARMX = XBAR
C
C...Write out statistics
C
      WRITE(53,9005) ICON, LOOP2, XBAR/100, X50/100
 9005 FORMAT(T8,I3,T24,I3,T40,F10.4,T60,F10.4)
C
C...write out MAPPER instructions
C
      DO 500 IPLT = 1,3
C
C......assign title (based on consequence)
C
          IF (ICON.EQ.1) THEN
             TITLE1 = 'EARLY FATALITIES                              '
          ELSEIF (ICON.EQ.2) THEN
             TITLE1 = 'EARLY INJURIES                                '
          ELSEIF (ICON.EQ.3) THEN
             TITLE1 = 'EARLY FATALITY RISK, 1 MILE                   '
          ELSEIF (ICON.EQ.4) THEN
             TITLE1 = 'TOTAL LATENT CANCER FATALITIES                '
          ELSEIF (ICON.EQ.5) THEN
             TITLE1 = 'POPULATION DOSE WITHIN 50 MILES               '
          ELSEIF (ICON.EQ.6) THEN
             TITLE1 = 'POPULATION DOSE WITHIN 1000 MILES             '
          ELSEIF (ICON.EQ.7) THEN
             TITLE1 = 'TOTAL ECONOMIC COST                           '
          ELSEIF (ICON.EQ.8) THEN
             TITLE1 = 'EARLY FATALITY RISK, 0-1 MILE                 '
          ELSEIF (ICON.EQ.9) THEN
             TITLE1 = 'CANCER FATALITY RISK, 0-10 MILES              '
          ENDIF
C
C......assign subtitle (based on type of plot)
C
          IF (IPLT.EQ.1) THEN
             TITLE2 = 'UNCERTAINTY IN FRACTIONAL CONTRIBUTION'
          ELSEIF (IPLT.EQ.2) THEN
             TITLE2 = 'MEAN FRACTIONAL CONTRIBUTION                  '
          ELSEIF (IPLT.EQ.3) THEN
             TITLE2 = 'MEDIAN FRACTIONAL CONTRIBUTION                '
          ENDIF
C
C......determine lower and upper bounds for y-axis
C
      IF (LOOP2.EQ.1) THEN
          ILOWER = 1
          IUPPER = NYVAL
          GO TO 49
```

```
      ENDIF
C
      IF (LOOP2.EQ. NYVAL + 1) THEN
         ILOWER = NYVAL + 1
         IF (NPAGE.EQ.2) THEN
            IUPPER = NPDS
         ELSE
            IUPPER = 2 * NYVAL
         ENDIF
         GO TO 49
      ENDIF
C
      IF (LOOP2.EQ. 2*NYVAL + 1) THEN
         ILOWER = 2 * NYVAL + 1
         IF (NPAGE.EQ.3) THEN
            IUPPER = NPDS
         ELSE
            IUPPER = 3 * NYVAL
         ENDIF
         GO TO 49
      ENDIF
C
      IF (LOOP2.EQ. 3*NYVAL + 1) THEN
         ILOWER = 3 * NYVAL + 1
         IUPPER = NPDS
         GO TO 49
      ENDIF
C
   49 CONTINUE
C
C......determine which type of plot to make
C
         IF (IPLT.EQ.1) THEN
            GO TO 100
C...                                ... boxplots
         ELSEIF (IPLT.EQ.2) THEN
            GO TO 200
C...                                ... mean plots
         ELSEIF (IPLT.EQ.3) THEN
            GO TO 300
C...                                ... median plots
         ENDIF
C
  100 CONTINUE
C
C...*** Boxplots ***
      IF (((LOOP2.EQ.1).OR.(LOOP2.EQ.NYVAL + 1).OR.
     $    (LOOP2.EQ. 2 * NYVAL + 1).OR.(LOOP2.EQ. 3 * NYVAL + 1))
     $    .AND. (LOOP2.NE.NPDS)) THEN
C
C......start a MAPPER slide
C
         WRITE(50,3899) ICON
 3899 FORMAT('*' /  '*' / '*CON',I1,'*' / '*' /)
         WRITE(50,3900)
```

```
 3900 FORMAT('*' / '*' /
     $        'NO DRAW' / 'START(' /
     $        'PROJECTIT(7,5.5,11,14,0,11,0,14,90' /
     $        'DRAW' / 'BLUE' / 'SWISSL(' / 'LINK' /
     $        'NO DRAW' / 'BOX(6,6.5,9,10' / 'DRAW' / '*' /
     $        '* CONSTRUCT THE BOXPLOTS FOR PDS 1 - 7'/ '*' )
C
C......draw the axes
         IX = (INT(XBIG(LOOP1)/10)+1)*10
         IF (IX.GT.100) IX = 100
         YTOP = FLOAT(IUPPER) + .5
         IF (NYVAL.LT.10) THEN
            WRITE(50,4000) IX,ILOWER-1,IUPPER,IX,ILOWER-1,
     $                        ILOWER-1,YTOP
 4000 FORMAT( '*' /
     $         'X-AXIS(0,10,',I3 /
     $         'Y-AXIS(',I3,',1,',I2,',,,,-2' / '*' /
     $         '* RETRACE THE AXIS' / '*' /
     $         'ROAD(-.02' / 'LINE(',I3,',',I3,',1' / '0,',I3 /
     $         '0,',E10.4,',2' / 'RED')
         ELSE
            WRITE(50,4001) IX,IX,ILOWER-1,IUPPER,IX,ILOWER-1,
     $                        ILOWER-1,YTOP
 4001 FORMAT( '*' /
     $         'X-AXIS(0,10,',I3 /
     $         'X-AXIS(0,10,',I3,',,.12,0' /
     $         'Y-AXIS(',I3,',1,',I2,',,,,-2' / '*' /
     $         '* RETRACE THE AXIS' / '*' /
     $         'ROAD(-.02' / 'LINE(',I3,',',I3,',1' / '0,',I3 /
     $         '0,',E10.4,',2' / 'RED')
         ENDIF
      ENDIF
C
C......trace the endlines
C
         WRITE(50,2000) LOOP2
 2000    FORMAT('*' / '*PD',I3,'*' / '*' /
     $          '* TRACE THE ENDLINES' / '*')
         WRITE(50,2100) PTMAX,Y1,PTMAX,Y2
 2100    FORMAT('ROAD(-.02' /
     $          'LINE(',E10.4,',',E10.4,',1' / E10.4,',',E10.4,',2')
         WRITE(50,2100) PTMIN,Y1,PTMIN,Y2
C
C......construct the box
C
         IF (ABS(XIQR).LT. 0.025) THEN
            WRITE(50,2200) XCENT,LOOP2,YLEN
 2200       FORMAT('*' / '* CONSTRUCT THE BOX' / '*' /
     $             'ROAD(-.02' / 'BOX(',E10.4,',',I3,',.025,',E10.4)
         ELSE
C
            WRITE(50,2210) XCENT,LOOP2,XIQR,YLEN
 2210       FORMAT('*' / '* CONSTRUCT THE BOX' / '*' /
     $             'ROAD(-.02' / 'BOX(',E10.4,',',I3,',',E10.4,',',E10.4)
         ENDIF
```

```
C
C......put in the median line
C
         WRITE(50,2300) X50, YMED1, X50, YMED2
 2300    FORMAT('*' / '* PUT IN THE MEDIAN LINE' / '*' /
     $          'ROAD(-.02' / 'LINE(',E10.4,',',E10.4,',1' /
     $          E10.4,',',E10.4,',2')
C
C......connect the endlines with the box
C
         WRITE(50,2400)
 2400    FORMAT('*' / '* CONNECT THE ENDLINES WITH THE BOX' / '*')
         WRITE(50,2500) X75, LOOP2, PTMAX, LOOP2
         WRITE(50,2500) X25, LOOP2, PTMIN, LOOP2
 2500    FORMAT('ROAD(-.02' / 'LINE(',E10.4,',',I3,',1' /
     $          E10.4,',',I3,',2')
C
C......plot outlier points (if any)
C
         OPEN(UNIT=49,FILE='TEMP.FIL',STATUS='NEW')
C
         KOUNT = 0
         I = 1
C
   60    IF (WORK(I).LT.PTMIN) THEN
           KOUNT = KOUNT + 1
            WRITE(49,2600) WORK(I)
 2600       FORMAT(E10.4)
            I = I + 1
            GO TO 60
         ENDIF
C
   70    IF (WORK(NRISK-I+1).GT.PTMAX)THEN
            KOUNT = KOUNT + 1
            WRITE(49,2600) WORK(NRISK-I+1)
            I = I + 1
            GO TO 70
         ENDIF
C
         IF (KOUNT.GT.0) THEN
            WRITE(50,2700) KOUNT
 2700       FORMAT('*' / '* PLOT OUTLIER POINTS' / '*' /
     $             'PLOTIT(',I3,',-1,4')
            REWIND 49
            DO 80 I = 1,KOUNT
               READ(49,*) Y
               WRITE(50,2800) Y,LOOP2
 2800          FORMAT(E10.4,',',I3)
   80       CONTINUE
         ENDIF

         CLOSE(49,STATUS='DELETE')
C
C.....plot the mean
C
```

```
      WRITE(50,2701) XBAR, LOOP2
 2701 FORMAT('*' / '* PLOT THE MEAN' / '*' /'BLUE'/
     $       'PLOTIT(1,-1,15',/E10.4,',',I2/'RED')
C
C.....assign labels & titles to the MAPPER slide
C.......to end the slide
C
      IF (LOOP2.EQ.IUPPER) THEN
C
      CALL CONCAT(PLANT,TITLE1,TYPE,HEADER)
      WRITE(50,3950) YLABEL, HEADER,  TITLE2
 3950 FORMAT('*' / '*LABEL THE HORIZONTAL AND VERTICAL AXES' /
     $        '*' / 'REVERT' / 'BLUE' / 'LABEL(1,,6,.5,5,1' /
     $        '&I.35>PERCENT CONTRIBUTION' /
     $        'LABEL(1,,.5,6.5,5,1,90' /
     $        '&I.35>',A /
     $        '*' / '* TITLE' / '*' /
     $        'LABEL(3,,5.5,13.25,11,2,0' /
     $        '&I.35>',A  / /
     $        '&I.35>',A /
     $        'END' / '*' )
      ENDIF
C
      GO TO 500
C
  200 CONTINUE
C
C...***  Mean plots ***
C
      IF ((LOOP2.EQ.1).OR.(LOOP2.EQ.NYVAL + 1).OR.
     $    (LOOP2.EQ. 2 * NYVAL + 1)) THEN
C
C......start a MAPPER slide
C
         WRITE(51,3899) ICON
         WRITE(51,3901)
 3901 FORMAT('*' / '*' /
     $        'NO DRAW' / 'START(' /
     $        'PROJECTIT(7,5.5,11,14,0,11,0,14,90' /
     $        'DRAW' / 'BLUE' / 'SWISSL(' / 'LINK' /
     $        'NO DRAW' / 'BOX(6,6.5,9,10' / 'DRAW' / '*' /
     $        '* CONSTRUCT THE MEAN PLOTS FOR PDS 1 - 7'/ '*' )
C
C......draw the axes
C
         IX = (INT(XBARMX/10)+1)*10
         IF (IX.GT.100) IX = 100
         YTOP = FLOAT(IUPPER) + .5
         IF (NYVAL.LT.10) THEN
            WRITE(51,4000) IX,ILOWER-1,IUPPER,IX,ILOWER-1,
     $                        ILOWER-1,YTOP
         ELSE
            WRITE(51,4001) IX,IX,ILOWER-1,IUPPER,IX,ILOWER-1,
     $                        ILOWER-1,YTOP
         ENDIF
```

```
       ENDIF
C
      WRITE(51,2900) LOOP2, XBAR, LOOP2
 2900 FORMAT('*' / '* PLOT THE MEAN' / '*' /'RED'/
     $        'ROAD(-.1' /
     $        'LINE(0,',I2,',1' /
     $        E10.4,',',I2,',2')
C
C.....assign labels & titles to the MAPPER slide
C
      IF ((LOOP2.EQ.NYVAL).OR.(LOOP2.EQ. 2*NYVAL).OR.
     $    (LOOP2.EQ.NPDS)) THEN
         CALL CONCAT(PLANT,TITLE1,TYPE,HEADER)
         WRITE(51,3950) YLABEL, HEADER,  TITLE2
      ENDIF
C
      GO TO 500
C
  300 CONTINUE
C
C...*** Median plots ***
C
      IF ((LOOP2.EQ.1).OR.(LOOP2.EQ.NYVAL + 1).OR.
     $    (LOOP2.EQ. 2 * NYVAL + 1)) THEN
C
C......start a MAPPER slide
C
         WRITE(52,3899) ICON
         WRITE(52,3902)
 3902 FORMAT('*' / '*' /
     $        'NO DRAW' / 'START(' /
     $        'PROJECTIT(7,5.5,11,14,0,11,0,14,90' /
     $        'DRAW' / 'BLUE' / 'SWISSL(' / 'LINK' /
     $        'NO DRAW' / 'BOX(6E,6.5,9,10' / 'DRAW' / '*' /
     $        '* CONSTRUCT THE MEDIAN PLOTS FOR PDS 1 - 7'/ '*' )
C
C......draw the axes
C
         IX = (INT(X50MAX/10)+1)*10
         IF (IX.GT.100) IX = 100
         YTOP = FLOAT(IUPPER) + .5
         IF (NYVAL.LT.10) THEN
            WRITE(52,4000) IX,ILOWER-1,IUPPER,IX,ILOWER-1,
     $                           ILOWER-1,YTOP
         ELSE
            WRITE(52,4001) IX,IX,ILOWER-1,IUPPER,IX,ILOWER-1,
     $                           ILOWER-1,YTOP
         ENDIF
       ENDIF
C
C.....plot the median
C
      WRITE(52,3200) LOOP2, X50, LOOP2
 3200 FORMAT('*' / '* PLOT THE MEDIAN' / '*' /
     $        'ROAD(-.1' /
```

```
     $       'LINE(0,',I2,',1' /
     $       E10.4,',',I2,',2')
C
C.....assign labels & titles to the MAPPER slide
C
      IF ((LOOP2.EQ.NYVAL).OR.(LOOP2.EQ. 2*NYVAL).OR.
     $    (LOOP2.EQ.NPDS)) THEN
         CALL CONCAT(PLANT,TITLE1,TYPE,HEADER)
         WRITE(52,3950) YLABEL, HEADER,  TITLE2
      ENDIF
C
      GO TO 500
C
  500 CONTINUE
C
   40 CONTINUE
C
      KASES(LOOP1) = KASES(LOOP1) + (N - NRISK)
      WRITE(*,3000) ICON,XBIG(LOOP1)
 3000 FORMAT(' MAXIMUM OVERALL X FOR ICON = ',I1,' IS:  ',E10.4)
C
    5 CONTINUE
C
C...Output # KASES with no risk
C
      WRITE(53,8000)
 8000 FORMAT(///// T20,'CONSEQUENCE',T40,'# CASES WITH NO RISK' /
     $              T20,'***********',T40,'********************' //)
      DO 18 I=1,NCONSQ
         WRITE(53,8010) KCONSQ(I), KASES(I)
 8010    FORMAT(T25,I2,T49,I4)
   18 CONTINUE
C
      STOP 'NORMAL TERMINATION'
      END
C
C*******************************************************************
      SUBROUTINE CONCAT(PLANT,TITLE1,TYPE,HEADER)
C
C     Concatenates PLANT, TITLE1, and TYPE into variable HEADER
C
      CHARACTER*(*) PLANT, TITLE1, TYPE, HEADER
C
C...move plant
C
      HEADER = PLANT
C
C...move title1
C
      LOCAT = INDEX(PLANT,'  ')
      HEADER(LOCAT:) = ': ' // TITLE1
C
C...move type
C
      LOCAT = INDEX(HEADER,'  ')
```

```
      HEADER(LOCAT:) = ' - ' // TYPE
C
      RETURN
      END
C
C*****************************************************************
      SUBROUTINE SIFT (N,X)
C
C     SHELL SORT
C
      DIMENSION X(1)
      M=N
   10 M=M/2
      IF (M.EQ.0) RETURN
      K=N-M
      J=1
   40 I=J
   50 L=I+M
      IF (X(I).LE.X(L)) GO TO 70
      A=X(I)
      X(I)=X(L)
      X(L)=A
      I=I-M
      IF (I.GT.0) GO TO 50
   70 J=J+1
      IF (J-K) 40,40,10
      END
C**********************************************************************
      SUBROUTINE FRACON
C
      PARAMETER(MAXPDS=80,MAXN=250,MAXCSQ=10)
      COMMON /XARRAY/ X(MAXN,MAXCSQ*MAXPDS), KCONSQ(MAXCSQ),
     $                KPDS(MAXPDS), NPDS, NCONSQ, NV, N, INFILE
C
      CHARACTER*10 INFILE
C
      OPEN(UNIT=5, FILE=INFILE, STATUS='OLD')
C
      READ(5,*)NPDS,(KPDS(I),I=1,NPDS),NCONSQ,(KCONSQ(I),I=1,NCONSQ)
      NV = NPDS*NCONSQ
      I = 1
C
    1 READ(5,*,END=6)(X(I,J),J=1,NV)
C
      DO 2 K = 1,NCONSQ
         SUM = 0.
C
         DO 3  J = 1,NPDS
            SUM = SUM + X(I,J + (K-1)*NPDS)
    3    CONTINUE
C
         DO 4 J = 1,NPDS
            IF(SUM .GT. 0.)THEN
               X(I,J + (K-1)*NPDS) = X(I,J + (K-1)*NPDS)/SUM
            ELSE
```

```
                X(I,J + (K-1)*NPDS) = 9.
             ENDIF
    4     CONTINUE
C
    2 CONTINUE
C
      I = I + 1
      GO TO 1
C
C...determine sample size
C
    6 N = I - 1
C
      RETURN
      END
```

APPENDIX B

PARTIAL OUTPUT FOR FRACTIONAL CONTRIBUTION ANALYSIS FOR METHOD 1

This appendix contains some of the output generated for a fractional contribution analysis of the Surry plant based on Method 1 of Section 4, which computes the average fractional contribution. A brief explanation of the output contained in this appendix is as follows:

Page(s)	
B-2	The top of the page echoes the files used in the analysis along with characteristics of the files. The bottom portion of the page contains the average fractional contribution by plant damage state for each consequence measure. Note that each of the nine columns in this analysis will total to 1.
B-3	This page contains the average fractional contribution by source term group for each consequence measure. The groups used in this analysis were defined by the PARTITION program. Note that each of the nine columns in this analysis will total to 1.
B-4 to B-5	These pages contain the average fractional contribution by accident progression bin characteristic for each of the 11 attributes used to classify the accident progression bins (see page 13 of the user's guide). This analysis is broken down by the type of consequence. Note that each of the 11 columns will total to 1 for a given consequence measure.
B-6 to B-7	These pages contain the average fractional contribution by accident progression bin characteristic for each of the nine consequence measures. This analysis is broken down by the 11 attributes used to classify the accident progression bins. Note that each of the nine columns will total to 1 for a given attribute.
B-8 to B-12	These pages contain the average fractional contribution by accident progression bin for each of the nine consequence measures. Two numbers appear under each column that is headed by a consequence measure. The first number in a given row is the contribution corresponding to the accident progression bin identified in that row and the second number is the cumulative total as one goes down the column. Note the accident progression bins in each column appear in decreasing order based on the magnitude of their contribution. The printout continues until each of the three measures totals at least .99. The printout for the remaining six consequences has been omitted to save space.

<> <> PRA MODEL INTEGRATION SYSTEM - SNLA (JUNE 1989) <> <>

SURRY - AVERAGE FRACTIONAL CONTRIBUTION TO RISK

```
SMP   [RLIMAN.PRAMIS]LHS.DAT

PDS   [RLIMAN.PRAMIS]PDS.DAT

MBL   [RLIMAN.PRAMIS]MBL.DAT

APB   [RLIMAN.PRAMIS]APB.DAT

PAR   [RLIMAN.PRAMIS]PAR.DAT

CSQ   [RLIMAN.PRAMISCSQS.DAT

NAM   FRACON

FRC   SMP

END   CSQ


  200 SAMPLES
   11-CHARACTER BIN ID DESCRIPTORS
    7 OF      7 PLANT DAMAGE STATES SPECIFIED
 1906 OF   1906 ACCIDENT PROGRESSION BINS SPECIFIED
   52 OF     52 SOURCE TERM PARTITIONS SPECIFIED
    9 OF      9 CONSEQUENCE MEASURES SPECIFIED

MATRIX MULTIPLICATIONS WILL BE TERMINATED FOLLOWING COMPUTATION OF CSQ
```

FRACTIONAL CONTRIBUTIONS OF PDS TO CSQ, NORMALIZED ON A SAMPLE BASIS

PDS \ CSQ	1	2	3	4	5	6	7	8	9
1	0.07745	0.06384	0.07562	0.15198	0.17880	0.15306	0.13968	0.09929	0.20827
2	0.00623	0.00558	0.00663	0.04007	0.05022	0.04062	0.03397	0.00886	0.05775
3	0.01344	0.01402	0.01242	0.03597	0.04267	0.03628	0.03197	0.01995	0.04898
4	0.57409	0.66728	0.59806	0.15851	0.14949	0.15829	0.18497	0.56448	0.19930
5	0.00274	0.00236	0.00207	0.00780	0.00850	0.00780	0.00842	0.00365	0.00932
6	0.03654	0.02830	0.03021	0.03610	0.03658	0.03589	0.03847	0.03834	0.04782
7	0.28950	0.21863	0.27499	0.56956	0.53374	0.56806	0.56253	0.26543	0.42856

FRACTIONAL CONTRIBUTIONS OF PAR TO CSQ, NORMALIZED ON A SAMPLE BASIS

PAR	CSQ 1	2	3	4	5	6	7	8	9
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.00004	0.00001	0.00002	0.00005	0.00005	0.00005	0.00003	0.00010	0.00006
3	0.02455	0.06927	0.03620	0.00106	0.00260	0.00102	0.00021	0.04379	0.01068
4	0.00000	0.00000	0.00001	0.00001	0.00002	0.00001	0.00000	0.00001	0.00003
5	0.05024	0.01249	0.04276	0.00217	0.00197	0.00208	0.00494	0.03543	0.00657
6	0.05708	0.12767	0.07956	0.02073	0.02751	0.02047	0.01915	0.09013	0.03759
7	0.00426	0.00299	0.00523	0.00071	0.00060	0.00072	0.00155	0.00493	0.00026
8	0.02507	0.00269	0.02244	0.00320	0.00373	0.00323	0.00464	0.01814	0.00677
9	0.08141	0.14037	0.11832	0.04738	0.04823	0.04736	0.05713	0.12521	0.04934
10	0.02289	0.01041	0.03250	0.07693	0.06402	0.07645	0.07763	0.03178	0.04305
11	0.00294	0.01142	0.00076	0.02749	0.02840	0.02721	0.03339	0.00541	0.02691
12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00274	0.00052	0.00432	0.00054	0.00065	0.00050	0.00047	0.00412	0.00272
15	0.02551	0.01931	0.02287	0.00865	0.00738	0.00885	0.01123	0.01872	0.00793
16	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
17	0.00309	0.00212	0.00291	0.00148	0.00166	0.00150	0.00153	0.00630	0.00390
18	0.13990	0.10702	0.12121	0.02619	0.02055	0.02629	0.03309	0.10099	0.02986
19	0.00061	0.00177	0.00021	0.00432	0.00426	0.00432	0.00449	0.00018	0.00112
20	0.08563	0.04742	0.09344	0.01617	0.01790	0.01607	0.02165	0.08904	0.04474
21	0.09034	0.08987	0.10513	0.02459	0.02014	0.02436	0.02693	0.09503	0.02899
22	0.01538	0.00855	0.02224	0.05090	0.04268	0.05087	0.05175	0.00927	0.02280
23	0.04499	0.05204	0.02555	0.03627	0.03035	0.03588	0.04098	0.08028	0.03208
24	0.00192	0.00386	0.00334	0.00005	0.00004	0.00005	0.00005	0.00273	0.00006
25	0.03454	0.02104	0.04688	0.08587	0.07040	0.08560	0.08581	0.03740	0.04356
26	0.01077	0.01484	0.01159	0.03268	0.03546	0.03246	0.03644	0.01563	0.03770
27	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
28	0.00267	0.00417	0.00016	0.00327	0.00298	0.00322	0.00380	0.00012	0.00061
29	0.00389	0.00282	0.00577	0.00137	0.00131	0.00138	0.00139	0.00577	0.00426
30	0.03482	0.02612	0.02552	0.00842	0.00668	0.00842	0.00978	0.02016	0.00847
31	0.01684	0.01706	0.00639	0.01745	0.01707	0.01723	0.01959	0.00395	0.00498
32	0.02112	0.02456	0.00302	0.01715	0.01200	0.01720	0.01934	0.00276	0.02059
33	0.11857	0.08378	0.08592	0.02145	0.01636	0.02148	0.02740	0.06772	0.02638
34	0.02877	0.02581	0.02448	0.03599	0.03411	0.03604	0.03716	0.01959	0.01640
35	0.00916	0.03557	0.01103	0.01327	0.01179	0.01334	0.01531	0.02779	0.01605
36	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
37	0.02736	0.02315	0.02899	0.05259	0.04562	0.05246	0.05229	0.01673	0.02326
38	0.00488	0.00451	0.00635	0.00240	0.00138	0.00239	0.00288	0.00993	0.00111
39	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
40	0.00358	0.00410	0.00420	0.02773	0.02231	0.02763	0.02632	0.00253	0.00988
41	0.00000	0.00000	0.00000	0.00001	0.00001	0.00001	0.00001	0.00000	0.00001
42	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00015	0.00037	0.00023	0.00690	0.00000	0.00009
44	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
45	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
46	0.00000	0.00000	0.00000	0.00087	0.00232	0.00137	0.00433	0.00000	0.00081
47	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
48	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
49	0.00000	0.00037	0.00000	0.24998	0.31972	0.25385	0.18031	0.00000	0.35945
50	0.00445	0.00228	0.00070	0.08046	0.07737	0.07842	0.08009	0.00835	0.07094
51	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
52	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 1, NORMALIZED ON A SAMPLE BASIS

CSQ 1

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.34542	0.01309	0.75116	0.01115	0.12535	0.20018	0.83622	0.56507	0.04866	0.00447	0.84321
B	0.22867	0.00000	0.01361	0.09040	0.72304	0.15236	0.05717	0.43493	0.04446	0.06598	0.15679
C	0.00531	0.00000	0.10661	0.10651	0.02602	0.64746	0.00000		0.06364	0.33786	
D	0.08300	0.17763	0.07553	0.79195	0.05421		0.10661		0.84324	0.59169	
E	0.00454	0.00000	0.03525		0.00539						
F	0.13001	0.02109	0.01784		0.06599						
G	0.20305	0.00956									
H		0.77863									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 2, NORMALIZED ON A SAMPLE BASIS

CSQ 2

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.24878	0.01003	0.80790	0.00940	0.09967	0.14437	0.83683	0.56102	0.04134	0.00432	0.86627
B	0.41850	0.00000	0.01243	0.07036	0.75658	0.11573	0.05296	0.43898	0.03691	0.06188	0.13373
C	0.00800	0.00000	0.11021	0.08272	0.02171	0.73991	0.00000		0.04887	0.33506	
D	0.07719	0.13607	0.02911	0.83752	0.05102		0.11021		0.87288	0.59874	
E	0.00341	0.00000	0.02694		0.00573						
F	0.05856	0.01367	0.01342		0.06528						
G	0.18556	0.00904									
H		0.83118									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 3, NORMALIZED ON A SAMPLE BASIS

CSQ 3

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.28253	0.01404	0.78327	0.01146	0.12191	0.16443	0.86177	0.56988	0.04692	0.00264	0.85285
B	0.31553	0.00000	0.01508	0.08669	0.74755	0.16470	0.05476	0.43012	0.04061	0.06419	0.14715
C	0.00676	0.00000	0.08346	0.09695	0.02391	0.67087	0.00000		0.06340	0.36499	
D	0.07625	0.14252	0.06415	0.80490	0.05205		0.08346		0.84907	0.56818	
E	0.00658	0.00000	0.03449		0.00512						
F	0.12713	0.02093	0.01956		0.04947						
G	0.18522	0.00974									
H		0.81276									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 4, NORMALIZED ON A SAMPLE BASIS

CSQ 4

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.06259	0.01284	0.59767	0.01074	0.25942	0.17506	0.80518	0.58001	0.09295	0.00647	0.71594
B	0.09592	0.00000	0.04537	0.18135	0.55991	0.44359	0.04625	0.41999	0.11073	0.05365	0.28406
C	0.00235	0.00000	0.14857	0.22664	0.05244	0.38134	0.00000		0.10847	0.40901	
D	0.07468	0.22452	0.08925	0.58126	0.03946		0.14857		0.68785	0.53087	
E	0.01984	0.00000	0.09121		0.00030						
F	0.31450	0.08898	0.02793		0.08847						
G	0.43012	0.02591									
H		0.64775									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 5, NORMALIZED ON A SAMPLE BASIS

CSQ 5

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.04673	0.01175	0.59294	0.01152	0.24974	0.17096	0.81393	0.57557	0.09216	0.00629	0.68700
B	0.10275	0.00000	0.04322	0.17610	0.57787	0.41038	0.03830	0.42443	0.10676	0.04407	0.31300
C	0.00206	0.00000	0.14776	0.21939	0.05265	0.41866	0.00000		0.10364	0.44710	
D	0.06513	0.23861	0.10385	0.59300	0.03149		0.14776		0.69744	0.50255	
E	0.02019	0.00000	0.08684		0.00017						
F	0.35190	0.11430	0.02538		0.08807						
G	0.41123	0.03283									
H		0.60251									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 6, NORMALIZED ON A SAMPLE BASIS

CSQ 6

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.06277	0.01269	0.59879	0.01076	0.25915	0.17255	0.80731	0.57987	0.09285	0.00646	0.71514
B	0.09552	0.00000	0.04544	0.18121	0.56162	0.44393	0.04584	0.42013	0.11061	0.05314	0.28486
C	0.00230	0.00000	0.14685	0.22627	0.05240	0.38352	0.00000		0.10838	0.41120	
D	0.07410	0.22333	0.08977	0.58175	0.03905		0.14685		0.68816	0.52919	
E	0.01986	0.00000	0.09137		0.00029						
F	0.31684	0.09000	0.02779		0.08749						
G	0.42861	0.02622									
H		0.64776									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 7, NORMALIZED ON A SAMPLE BASIS

CSQ 7

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.08086	0.01471	0.59352	0.01208	0.25453	0.19479	0.77696	0.57862	0.09067	0.00607	0.72805
B	0.10411	0.00000	0.04235	0.17566	0.54435	0.42249	0.05473	0.42137	0.10788	0.06463	0.27194
C	0.00285	0.00000	0.16831	0.22469	0.05069	0.38272	0.00000		0.10749	0.37123	
D	0.08586	0.23641	0.08073	0.58757	0.04824		0.16831		0.69397	0.55808	
E	0.01891	0.00000	0.08621		0.00081						
F	0.26822	0.07038	0.02888		0.10138						
G	0.43920	0.02141									
H		0.65709									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 8, NORMALIZED ON A SAMPLE BASIS

CSQ 8

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.22780	0.01798	0.74826	0.01388	0.12388	0.20840	0.78945	0.56773	0.04671	0.00265	0.81216
B	0.33668	0.00000	0.01131	0.08468	0.69495	0.11982	0.07794	0.43227	0.04268	0.09031	0.18784
C	0.00942	0.00000	0.13261	0.09811	0.02225	0.67178	0.00000		0.06217	0.33789	
D	0.10214	0.18962	0.06116	0.80333	0.07541		0.13261		0.84843	0.56915	
E	0.00665	0.00000	0.02518		0.00544						
F	0.10078	0.02290	0.02148		0.07807						
G	0.21652	0.01264									
H		0.75686									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 9, NORMALIZED ON A SAMPLE BASIS

CSQ 9

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.06838	0.01162	0.58727	0.01348	0.21384	0.21566	0.78185	0.56236	0.08148	0.00621	0.64985
B	0.13092	0.00000	0.03083	0.14560	0.60574	0.27474	0.03770	0.43764	0.08734	0.04387	0.35015
C	0.00203	0.00000	0.18046	0.19247	0.04275	0.50960	0.00000		0.08817	0.45933	
D	0.06426	0.29192	0.12199	0.64845	0.03143		0.18046		0.74301	0.49060	
E	0.01946	0.00000	0.05900		0.00040						
F	0.34700	0.13634	0.02044		0.10584						
G	0.36795	0.03922									
H		0.52090									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ, NORMALIZED ON A SAMPLE BASIS
APB ATTRIBUTE 1
CSQ

	1	2	3	4	5	6	7	8	9
A	0.34542	0.24878	0.28253	0.06259	0.04673	0.06277	0.08086	0.22780	0.06838
B	0.22867	0.41850	0.31553	0.09592	0.10275	0.09552	0.10411	0.33668	0.13092
C	0.00531	0.00800	0.00676	0.00235	0.00206	0.00230	0.00285	0.00942	0.00203
D	0.08300	0.07719	0.07625	0.07468	0.06513	0.07410	0.08586	0.10214	0.06426
E	0.00454	0.00341	0.00658	0.01984	0.02019	0.01986	0.01891	0.00665	0.01946
F	0.13001	0.05856	0.12713	0.31450	0.35190	0.31684	0.26822	0.10078	0.34700
G	0.20305	0.18556	0.18522	0.43012	0.41123	0.42861	0.43920	0.21652	0.36795

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ, NORMALIZED ON A SAMPLE BASIS
APB ATTRIBUTE 2
CSQ

	1	2	3	4	5	6	7	8	9
A	0.01309	0.01003	0.01404	0.01284	0.01175	0.01269	0.01471	0.01798	0.01162
B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
C	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
D	0.17763	0.13607	0.14252	0.22452	0.23861	0.22333	0.23641	0.18962	0.29192
E	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
F	0.02109	0.01367	0.02093	0.08898	0.11430	0.09000	0.07038	0.02290	0.13634
G	0.00956	0.00904	0.00974	0.02591	0.03283	0.02622	0.02141	0.01264	0.03922
H	0.77863	0.83118	0.81276	0.64775	0.60251	0.64776	0.65709	0.75686	0.52090

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ, NORMALIZED ON A SAMPLE BASIS
APB ATTRIBUTE 3
CSQ

	1	2	3	4	5	6	7	8	9
A	0.75116	0.80790	0.78327	0.59767	0.59294	0.59879	0.59352	0.74826	0.58727
B	0.01361	0.01243	0.01508	0.04537	0.04322	0.04544	0.04235	0.01131	0.03083
C	0.10661	0.11021	0.08346	0.14857	0.14776	0.14685	0.16831	0.13261	0.18046
D	0.07553	0.02911	0.06415	0.08925	0.10385	0.08977	0.08073	0.06116	0.12199
E	0.03525	0.02694	0.03449	0.09121	0.08684	0.09137	0.08621	0.02518	0.05900
F	0.01784	0.01342	0.01956	0.02793	0.02538	0.02779	0.02888	0.02148	0.02044

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ, NORMALIZED ON A SAMPLE BASIS
APB ATTRIBUTE 4
CSQ

	1	2	3	4	5	6	7	8	9
A	0.01115	0.00940	0.01146	0.01074	0.01152	0.01076	0.01208	0.01388	0.01348
B	0.09040	0.07036	0.08669	0.18135	0.17610	0.18121	0.17566	0.08468	0.14560
C	0.10651	0.08272	0.09695	0.22664	0.21939	0.22627	0.22469	0.09811	0.19247
D	0.79195	0.83752	0.80490	0.58126	0.59300	0.58175	0.58757	0.80333	0.64845

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ, NORMALIZED ON A SAMPLE BASIS
APB ATTRIBUTE 5
CSQ

	1	2	3	4	5	6	7	8	9
A	0.12535	0.09967	0.12191	0.25942	0.24974	0.25915	0.25453	0.12388	0.21384
B	0.72304	0.75658	0.74755	0.55991	0.57787	0.56162	0.54435	0.69495	0.60574
C	0.02602	0.02171	0.02391	0.05244	0.05265	0.05240	0.05069	0.02225	0.04275
D	0.05421	0.05102	0.05205	0.03946	0.03149	0.03905	0.04824	0.07541	0.03143
E	0.00539	0.00573	0.00512	0.00030	0.00017	0.00029	0.00081	0.00544	0.00040
F	0.06599	0.06528	0.04947	0.08847	0.08807	0.08749	0.10138	0.07807	0.10584

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ, NORMALIZED ON A SAMPLE BASIS
APB ATTRIBUTE 6
CSQ

	1	2	3	4	5	6	7	8	9
A	0.20018	0.14437	0.16443	0.17506	0.17096	0.17255	0.19479	0.20840	0.21566
B	0.15236	0.11573	0.16470	0.44359	0.41038	0.44393	0.42249	0.11982	0.27474
C	0.64746	0.73991	0.67087	0.38134	0.41866	0.38352	0.38272	0.67178	0.50960

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ, NORMALIZED ON A SAMPLE BASIS

APB ATTRIBUTE 7

CSQ

	1	2	3	4	5	6	7	8	9
A	0.83622	0.83683	0.86177	0.80518	0.81393	0.80731	0.77696	0.78945	0.78185
B	0.05717	0.05296	0.05476	0.04625	0.03830	0.04584	0.05473	0.07794	0.03770
C	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
D	0.10661	0.11021	0.08346	0.14857	0.14776	0.14685	0.16831	0.13261	0.18046

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ, NORMALIZED ON A SAMPLE BASIS

APB ATTRIBUTE 8

CSQ

	1	2	3	4	5	6	7	8	9
A	0.56507	0.56102	0.56988	0.58001	0.57557	0.57987	0.57862	0.56773	0.56236
B	0.43493	0.43898	0.43012	0.41999	0.42443	0.42013	0.42137	0.43227	0.43764

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ, NORMALIZED ON A SAMPLE BASIS

APB ATTRIBUTE 9

CSQ

	1	2	3	4	5	6	7	8	9
A	0.04866	0.04134	0.04692	0.09295	0.09216	0.09285	0.09067	0.04671	0.08148
B	0.04446	0.03691	0.04061	0.11073	0.10676	0.11061	0.10788	0.04268	0.08734
C	0.06364	0.04887	0.06340	0.10847	0.10364	0.10838	0.10749	0.06217	0.08817
D	0.84324	0.87288	0.84907	0.68785	0.69744	0.68816	0.69397	0.84843	0.74301

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ, NORMALIZED ON A SAMPLE BASIS

APB ATTRIBUTE 10

CSQ

	1	2	3	4	5	6	7	8	9
A	0.00447	0.00432	0.00264	0.00647	0.00629	0.00646	0.00607	0.00265	0.00621
B	0.06598	0.06188	0.06419	0.05365	0.04407	0.05314	0.06463	0.09031	0.04387
C	0.33786	0.33506	0.36499	0.40901	0.44710	0.41120	0.37123	0.33789	0.45933
D	0.59169	0.59874	0.56818	0.53087	0.50255	0.52919	0.55808	0.56915	0.49060

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ, NORMALIZED ON A SAMPLE BASIS

APB ATTRIBUTE 11

CSQ

	1	2	3	4	5	6	7	8	9
A	0.84321	0.86627	0.85285	0.71594	0.68700	0.71514	0.72805	0.81216	0.64985
B	0.15679	0.13373	0.14715	0.28406	0.31300	0.28486	0.27194	0.18784	0.35015

FRACTIONAL CONTRIBUTIONS OF APB TO CSQ, NORMALIZED ON SAMPLE BASIS

CSQ 1			CSQ 2			CSQ 3		
AHADBCAADDA	0.14098	0.14098	BHADBCAADDA	0.14090	0.14090	BHADBCAADDA	0.11363	0.11363
AHADBCABDDA	0.10005	0.24104	BHADBCABDDA	0.11013	0.25103	AHADBCAADDA	0.10984	0.22347
BHADBCAADDA	0.08455	0.32559	AHADBCAADDA	0.09586	0.34689	BHADBCABDDA	0.08364	0.30711
BHADBCABDDA	0.06305	0.38864	BHADBCAADCA	0.09052	0.43741	AHADBCABDDA	0.07585	0.38296
AHADBCAADCA	0.06038	0.44902	BHADBCABDCA	0.07435	0.51176	BHADBCAADCA	0.06624	0.44920
BHADBCAADCA	0.04458	0.49360	AHADBCABDDA	0.06629	0.57806	AHADBCAADCA	0.05584	0.50504
AHADBCABDCA	0.04192	0.53552	AHADBCAADCA	0.05010	0.62816	BHADBCABDCA	0.04983	0.55487
BHADBCABDCA	0.03535	0.57087	AHADBCABDCA	0.03487	0.66303	AHADBCABDCA	0.03917	0.59404
GDCDFADBDDB	0.02768	0.59856	GDCDFADBDDB	0.02709	0.69012	GDCDFADBDDB	0.02241	0.61645
DHADDCBBDBB	0.02217	0.62073	DHADDCBBDBB	0.01934	0.70947	DHADDCBBDBB	0.02067	0.63712
GDCDFADBDDA	0.01436	0.63509	DHADDCBADBB	0.01478	0.72425	GHADBBAADDA	0.01486	0.65198
GHADBBAADDA	0.01307	0.64815	GDCDFADADDB	0.01465	0.73890	GHADBBABDDA	0.01224	0.66422
GDCDFADADDB	0.01265	0.66081	GDCDFADBDDA	0.01088	0.74978	FHADBBAADCA	0.01191	0.67613
FDDDBAABDCB	0.01047	0.67128	GDCDFADADDA	0.00966	0.75944	GDCDFADBDDA	0.01039	0.68652
FHADBBAADCA	0.01039	0.68167	GHADBBAADDA	0.00843	0.76787	FHADBBABDCA	0.00924	0.69576
DHADDCBADBB	0.01009	0.69176	GHADBBABDDA	0.00736	0.77522	GDCDFADADDB	0.00922	0.70498
GHADBBABDDA	0.00940	0.70117	GDCBAADACDA	0.00683	0.78206	FDDDBAABDCB	0.00848	0.71346
GDCDFADADDA	0.00824	0.70941	FHADBBAADCA	0.00670	0.78875	GHACABAACDA	0.00791	0.72137
DAFDDCBADBB	0.00749	0.71689	GDCCAADBBDA	0.00635	0.79510	DAFDDCBADBB	0.00732	0.72869
FHADBBABDCA	0.00710	0.72400	DAFDDCBADBB	0.00629	0.80139	DHADDCBADBB	0.00720	0.73589
FDDDBAABDCA	0.00688	0.73088	FHADBBABDCA	0.00557	0.80697	GHEBABAACDA	0.00713	0.74302
FDDBBAAADCA	0.00670	0.73758	GHEBABAACDA	0.00472	0.81169	FDDDBAABDCA	0.00618	0.74920
GHEBABAACDA	0.00660	0.74418	GHACABAACDA	0.00429	0.81597	FHACABAACCA	0.00596	0.75516
GHACABAACDA	0.00644	0.75061	FDDBAAABCCA	0.00414	0.82011	FDDBBAAADCA	0.00589	0.76105
FFADBAAADCA	0.00589	0.75650	GHBBBBAADDA	0.00390	0.82402	FFADBAAADCA	0.00560	0.76665
GDCBAADACDA	0.00559	0.76209	DHACCBAABCA	0.00385	0.82787	GDCDFADADDA	0.00557	0.77222
FDDBAAABCCA	0.00532	0.76740	FHEBABAACCA	0.00356	0.83143	FHEBABAACCA	0.00538	0.77760
FDDCAAABBCA	0.00502	0.77242	DHAAECAAABB	0.00340	0.83483	FDDBAAABCCA	0.00493	0.78253
FHEBABAACCA	0.00498	0.77740	FHACABAACCA	0.00323	0.83807	GHACABAAADA	0.00480	0.78733
FHACABAACCA	0.00486	0.78226	DHEBABAABCA	0.00308	0.84115	FHADBBABDCB	0.00464	0.79197
FDDDBAAADCB	0.00471	0.78697	GHACABABBDA	0.00306	0.84421	FDDCAAABBCA	0.00463	0.79660
DHEBABAABCA	0.00442	0.79138	FHBBBBAADCA	0.00295	0.84716	GHBBBBAADDA	0.00425	0.80084
GHACABAAADA	0.00405	0.79543	DFACACABACB	0.00288	0.85004	FDDDBAAADCB	0.00412	0.80496
FDDDBAAADCA	0.00401	0.79944	FFADBAAADCA	0.00256	0.85260	GDCBAADACDA	0.00393	0.80890
GHBBBBAADDA	0.00390	0.80335	GHACABAAADA	0.00245	0.85505	GHACABABBDA	0.00370	0.81259
FDDCAAABCCA	0.00372	0.80706	GDCCAADBCDA	0.00233	0.85738	DHAAECAAABB	0.00345	0.81604
GHACABABBDA	0.00356	0.81062	GHEBBBAADDA	0.00223	0.85961	DFACACABACB	0.00342	0.81946
DHAAECAAABB	0.00345	0.81406	GDCBBADADDA	0.00221	0.86182	GHADBBAADDB	0.00339	0.82285
DFACACABACB	0.00338	0.81745	CFADBCABDCB	0.00218	0.86400	EHADBCAADCB	0.00324	0.82609
FHADBBABDCB	0.00336	0.82081	DFACACABAAA	0.00214	0.86614	FHBBBBAADCA	0.00321	0.82931
GDCCAADBBDA	0.00329	0.82410	GDCCAADAADA	0.00210	0.86824	FDDDBAAADCA	0.00319	0.83249
GHADBBAADDB	0.00300	0.82710	GHEBABAAADA	0.00206	0.87030	CFADBCABDCB	0.00318	0.83567
FHBBBBAADCA	0.00295	0.83005	GHADBBAADDB	0.00206	0.87236	GDCCAADBCDA	0.00286	0.83853
GDCCAADBCDA	0.00288	0.83293	EHADBCAADCB	0.00200	0.87436	FDDCAAABCCA	0.00276	0.84129
EHADBCAADCB	0.00283	0.83576	GDCBAADABDA	0.00197	0.87632	DAFDDCBBDBB	0.00273	0.84402
FGADBAAADCA	0.00258	0.83835	GHACCBABADA	0.00193	0.87826	FHADBBAADCB	0.00258	0.84660
DFAAACAAABA	0.00258	0.84092	DGAAACAAABA	0.00187	0.88013	GHEBABAABDA	0.00257	0.84918
GHEBABAAADA	0.00241	0.84334	BHADDCBADBB	0.00181	0.88194	FGADBAAADCA	0.00247	0.85165
GDCBAADABDA	0.00237	0.84570	GDCCCADBBDA	0.00178	0.88372	GHEBBBAADDA	0.00244	0.85409
FDDBCAAABCA	0.00231	0.84802	GDCCAADAADB	0.00178	0.88550	GHEBABAAADA	0.00239	0.85648
GHACCBABBDA	0.00230	0.85031	GDCDBADBDDB	0.00171	0.88722	GDCCAADBBDA	0.00236	0.85884
FHADBBAADCB	0.00228	0.85259	CGADBCAADCB	0.00170	0.88891	GHACCBABBDA	0.00230	0.86114
FDDCBAAADCB	0.00225	0.85485	FHEBBBAADCA	0.00168	0.89060	DHEBABAABCA	0.00227	0.86341
GHEBBBAADDA	0.00224	0.85709	FDDDBAABDCB	0.00168	0.89227	FDDBCAAABCA	0.00225	0.86566
DFACACABAAA	0.00216	0.85925	FHADBBABDCB	0.00163	0.89390	GHACCBAACDA	0.00225	0.86792
GDCCAADAADB	0.00215	0.86140	GDCBAADAADA	0.00161	0.89551	GDCCAADAADB	0.00224	0.87016
GHEBABAABDA	0.00211	0.86351	FHADBBAADCB	0.00156	0.89708	GHEBABABADA	0.00218	0.87234
GHACCBAACDA	0.00200	0.86550	DHACCBABACA	0.00149	0.89857	DHADDABADBB	0.00217	0.87451
FDDCBAABDCA	0.00199	0.86749	GDCCBADBDDA	0.00145	0.90001	DFAAACAAABA	0.00217	0.87668
GDCBAADAADA	0.00197	0.86946	GDDCAAABBDA	0.00142	0.90143	GDCBAADABDA	0.00215	0.87883
GHEBABABADA	0.00195	0.87141	FDDDBAABDCA	0.00140	0.90283	GDCBAADAADA	0.00202	0.88085
DHACCBABACA	0.00187	0.87328	GHADBBABDDB	0.00139	0.90422	GDCBAADBCDA	0.00196	0.88281
DAFDDCBBDBB	0.00187	0.87515	CHACBBAADCA	0.00138	0.90560	GHADBBABDDB	0.00190	0.88471
FHACBAAADCA	0.00183	0.87698	GDCBAADBCDA	0.00130	0.90691	FDDCBAAADCB	0.00186	0.88657
GHADBBABDDB	0.00183	0.87881	GHACABAABDA	0.00130	0.90820	FHEBBBAADCA	0.00184	0.88841
DHACCBAABCA	0.00180	0.88062	GHEBABABADA	0.00128	0.90949	DGAAACAAABA	0.00180	0.89021
DHADDABADBB	0.00178	0.88240	GDDBAAAACDA	0.00128	0.91077	FHACCBAACCA	0.00170	0.89191

GHACCBABADA	0.00175	0.88415
GDCDBADBDDB	0.00174	0.88589
FHEBBBAADCA	0.00169	0.88758
GDCBBADADDA	0.00163	0.88922
GHACABAABDA	0.00162	0.89083
GHBBABAACDA	0.00156	0.89240
FHACCBAACCA	0.00151	0.89390
GDCBAADBCDA	0.00150	0.89540
FDDCBAAADCA	0.00147	0.89687
DHADDBBADBB	0.00147	0.89834
CFADBCABDCB	0.00140	0.89975
DGAAACAAABA	0.00139	0.90113
EHACBCAADCA	0.00138	0.90252
GDCCBADBDDB	0.00138	0.90390
GHACBBABDDA	0.00137	0.90527
DHAAACAAABA	0.00132	0.90659
GDCBBADBDDA	0.00131	0.90789
FHACABAAACA	0.00128	0.90917
GDCCAADBCDB	0.00124	0.91041
FHADBAAADCA	0.00118	0.91160
FHBBABAACCA	0.00118	0.91278
GDCCBADBDDA	0.00117	0.91394
CGADBCAADCB	0.00115	0.91509
GDCCAADACDA	0.00115	0.91624
FHACABABBCA	0.00112	0.91736
AHADDCBADBB	0.00108	0.91844
GDDBAAAACDA	0.00105	0.91949
GHEBABABCDA	0.00105	0.92054
FHACBBABDCA	0.00104	0.92157
AHADDCBBDBB	0.00100	0.92258
DDCCCADABCA	0.00100	0.92358
GDCBFADADDA	0.00098	0.92456
FHEBABAABCA	0.00095	0.92551
FFABBAAADCA	0.00093	0.92644
GDCCAADAADA	0.00092	0.92735
GDCDBADBDDA	0.00090	0.92825
DFACCAAABCA	0.00089	0.92914
BHADDCBADBB	0.00088	0.93001
GDCCCADBADA	0.00088	0.93089
GDCCAADACDB	0.00086	0.93175
DHACABAAAAA	0.00084	0.93259
DAFAECAAABB	0.00083	0.93342
GDCCAADABDA	0.00082	0.93424
FFADBAABDCA	0.00082	0.93506
GDCDBADADDB	0.00081	0.93586
CGADBCABDCB	0.00080	0.93666
GDDBBAAADDA	0.00080	0.93746
FHEBABABCCA	0.00080	0.93826
GDCBFADBDDA	0.00079	0.93904
GDCCFADBDDA	0.00077	0.93981
FHEBABAAACA	0.00076	0.94057
DAFCDCBADBB	0.00073	0.94130
GHEBCBAACDA	0.00073	0.94203
FHACCBABBCA	0.00072	0.94276
GDDDBAABDDB	0.00069	0.94345
FDDCAAAAACA	0.00069	0.94414
GDDCBAABDDB	0.00068	0.94482
GHBBABAABDA	0.00068	0.94549
GHACABABADA	0.00066	0.94616
GDCBCADACDA	0.00066	0.94682
GDCCBADADDA	0.00066	0.94748
GDDBBAABDDA	0.00064	0.94812
FDDCBAABDCB	0.00064	0.94875
GDDCAAABBDA	0.00063	0.94939
DGACACABACB	0.00062	0.95000
FHEBABABACA	0.00061	0.95062
GDDDBAAADDB	0.00061	0.95123
DHACDCBADBB	0.00060	0.95183
GDCCCADBBDA	0.00060	0.95243

FGADBAAADCA	0.00126	0.91203
GDCCAADACDA	0.00121	0.91324
DGABACABBCA	0.00121	0.91445
DAFDDCBBDBB	0.00119	0.91564
GDCCAADBCDB	0.00118	0.91682
GHACCBABBDA	0.00118	0.91800
GHACCBAACDA	0.00115	0.91915
GHACBBABDDA	0.00114	0.92029
GDCCAADABDA	0.00114	0.92143
DHADDBBADBB	0.00113	0.92257
GHBBABAACDA	0.00112	0.92369
FDDBBAAADCA	0.00111	0.92480
GDDBBAAADDA	0.00108	0.92588
GHEBABABCDA	0.00106	0.92693
DHAAACAAABA	0.00100	0.92793
GHEBABAABDA	0.00098	0.92891
EHACBCAADCA	0.00098	0.92989
FHACABABBCA	0.00097	0.93086
GDCCFADBDDA	0.00097	0.93182
GDCDBADADDB	0.00093	0.93276
CGADBCABDCB	0.00088	0.93364
AHADDCBBDBB	0.00088	0.93451
GDDDBAABDDB	0.00087	0.93539
FHACCBAACCA	0.00087	0.93625
FHACBBABDCA	0.00086	0.93712
GDCCFADADDA	0.00086	0.93798
FHBBABAACCA	0.00085	0.93882
DAFAECAAABB	0.00082	0.93964
FHEBABABCCA	0.00080	0.94044
GDCCCADACDA	0.00079	0.94123
BHADDCBBDBB	0.00079	0.94201
GDCBCADACDA	0.00078	0.94279
AHADDCBADBB	0.00078	0.94357
FHACABAAACA	0.00077	0.94435
GDCCBADBDDB	0.00077	0.94512
GDCBBADBDDA	0.00072	0.94584
GDDCBAABDDA	0.00071	0.94655
DHADDABADBB	0.00069	0.94724
DDCCCADBACA	0.00069	0.94792
GDCDBADBDDA	0.00068	0.94860
FHADBAAADCA	0.00067	0.94927
FDDDBAAADCA	0.00065	0.94992
FHEBABAAACA	0.00065	0.95057
GHBBBBABDDA	0.00063	0.95120
DAFCDCBADBB	0.00062	0.95182
GDCDBADADDA	0.00061	0.95243
FHACCBABACA	0.00061	0.95304
DHACABAAAAA	0.00061	0.95365
DFAAACAAABA	0.00059	0.95425
DHAAECAACBB	0.00059	0.95484
GDCCBADADDB	0.00058	0.95542
FDDCAAABBCA	0.00058	0.95600
GDCBFADBDDA	0.00058	0.95658
FDDDBAAADCB	0.00057	0.95715
GDDDBAAADDB	0.00055	0.95770
GDCBFADADDA	0.00055	0.95825
CHADBCABDCB	0.00055	0.95880
DHACACABAAA	0.00054	0.95934
DGACACABAAA	0.00053	0.95988
DGACACABACB	0.00053	0.96040
FHBBBBABDCA	0.00052	0.96092
DHABACABBCA	0.00052	0.96144
GDDCAAAAADA	0.00050	0.96194
GHBBABAAADA	0.00047	0.96241
GDDBAAAABDA	0.00047	0.96288
DHADDBBBDBB	0.00045	0.96333
FDDCBAAADCB	0.00045	0.96378
DHEAECAAABB	0.00044	0.96422
DFCBACDBABA	0.00044	0.96466

BHADDCBADBB	0.00169	0.89360
GHBBABAACDA	0.00168	0.89528
DHAAACAAABA	0.00168	0.89696
EHACBCAADCA	0.00158	0.89855
DDCCCADABCA	0.00158	0.90013
GHACBBABDDA	0.00154	0.90167
FHACABAAACA	0.00152	0.90319
GDCDBADBDDB	0.00140	0.90459
GDCCBADBDDB	0.00140	0.90599
DFACCAAABCA	0.00140	0.90739
FHEBABAABCA	0.00139	0.90878
GDCCAADBCDB	0.00136	0.91014
CGADBCABDCB	0.00135	0.91149
GDCBBADBDDA	0.00133	0.91283
GDCCAADAADA	0.00133	0.91415
FHBBABAACCA	0.00127	0.91543
GDCCCADBADA	0.00118	0.91661
DHACCBABACA	0.00118	0.91778
FHACABABBCA	0.00117	0.91895
FHACBBABDCA	0.00116	0.92011
FHADBAAADCA	0.00114	0.92126
GHACABABADA	0.00114	0.92239
GHEBCBAACDA	0.00106	0.92345
DHACABAAAAA	0.00103	0.92448
FDDCBAABDCA	0.00101	0.92550
GHBBABAABDA	0.00097	0.92647
DGABACABBCA	0.00096	0.92743
FHACBAAADCA	0.00095	0.92839
AHADDCBADBB	0.00093	0.92932
FFABBAAADCA	0.00090	0.93022
AHADDCBBDBB	0.00089	0.93111
DAFAECAAABB	0.00083	0.93194
DHADDBBADBB	0.00081	0.93275
FHEBCBAACCA	0.00080	0.93355
GHACABAABDA	0.00078	0.93433
GDCCAADACDA	0.00078	0.93511
EHADBCABDAB	0.00076	0.93587
FHEBABAAACA	0.00075	0.93662
DAFCDCBADBB	0.00075	0.93737
DHADDBBBDBB	0.00074	0.93812
FDDCAAAAACA	0.00074	0.93886
CHADBCABDCB	0.00074	0.93959
GDDBAAAACDA	0.00074	0.94033
FHACCBABBCA	0.00073	0.94106
GDCCAADACDB	0.00069	0.94175
GDCBFADADDA	0.00069	0.94244
FHEBABABACA	0.00069	0.94313
GDDCBAABDDB	0.00069	0.94382
FDDCBAAADCA	0.00069	0.94450
GDCBCADACDA	0.00068	0.94518
GDCBBADADDA	0.00067	0.94585
GDDBBAABDDA	0.00065	0.94650
GDCDBADBDDA	0.00065	0.94715
GHACCBABADA	0.00064	0.94779
DGACACABACB	0.00063	0.94841
FFADBAABDCA	0.00062	0.94904
DGACCAAABCA	0.00062	0.94966
GHACABAABDB	0.00062	0.95027
DAFDDABBDBB	0.00061	0.95088
DHABDABBDBB	0.00061	0.95149
GDCDBADADDB	0.00059	0.95207
GHFDBBAADDA	0.00058	0.95265
GHDDBBAADDA	0.00058	0.95324
FDDCBAABDCB	0.00058	0.95382
GDCCCADBBDA	0.00057	0.95438
GHBBABAAADA	0.00057	0.95495
DHAADCBADBB	0.00056	0.95551
DHACDCBADBB	0.00056	0.95608
GDDCAAABCDA	0.00054	0.95661

GDDCBAABDDA	0.00057	0.95300	GDDCAAABCDA	0.00044	0.96509	GDDCAAAAADB	0.00053	0.95715
GHBBABAAADA	0.00057	0.95357	GHACABABCDA	0.00044	0.96553	DAFDDABADBB	0.00052	0.95767
GDDBAAAABDA	0.00056	0.95413	FDDBAAAACCA	0.00043	0.96596	DFCBACDBABA	0.00052	0.95819
FHACCBABACA	0.00055	0.95468	GDCCAADBADA	0.00043	0.96638	BHADDCBBDBB	0.00051	0.95870
FHEBCBAACCA	0.00055	0.95523	GDDCCAABBDA	0.00042	0.96681	GDDBAAAABDA	0.00051	0.95921
DHACACABAAA	0.00055	0.95578	DHEBABAAABA	0.00042	0.96723	GDDDBAAADDB	0.00050	0.95972
GDDCAAABCDA	0.00054	0.95632	GDDCAAAAADB	0.00042	0.96765	GHBBABABADA	0.00050	0.96022
DGACACABAAA	0.00054	0.95686	FHACABAABCA	0.00041	0.96806	GDDDBAABDDB	0.00049	0.96071
DHADDBBBDBB	0.00053	0.95739	GDCCAADABDB	0.00041	0.96847	CFADBCABDCA	0.00048	0.96119
DAFDDABADBB	0.00053	0.95793	FHEBABABACA	0.00041	0.96887	GDDBAAAAADA	0.00048	0.96167
GDCDBADADDA	0.00052	0.95845	GDDBAAAAADA	0.00038	0.96926	FDDCAAAACCA	0.00047	0.96213
DFCBACDBABA	0.00051	0.95896	FHEBABAABCA	0.00038	0.96964	FHBBBBABDCA	0.00047	0.96260
FHACABAABCA	0.00051	0.95947	GDDCBAABDDB	0.00038	0.97002	GHFCABAACDA	0.00046	0.96306
GDDCAAAAADB	0.00051	0.95998	CFADBCABDCA	0.00038	0.97039	FDDBAAAABCA	0.00045	0.96351
GHFDBBAADDA	0.00050	0.96048	FHACCBABBCA	0.00037	0.97076	FHDDBBAADCA	0.00045	0.96396
GHDDBBAADDA	0.00050	0.96098	GHEBBBABDDA	0.00036	0.97112	FHFDBBAADCA	0.00045	0.96441
FDDCAAAACCA	0.00048	0.96146	GHACABABADA	0.00035	0.97147	DHEAECAAABB	0.00044	0.96485
GDDBAAAAADA	0.00047	0.96193	GDDBBAABDDA	0.00035	0.97183	FHFCABAACCA	0.00042	0.96527
DHABDABBDBB	0.00047	0.96239	GDCBCADBBDA	0.00033	0.97216	GDCCFADBDDA	0.00042	0.96569
CHACBBAADCA	0.00046	0.96285	GDDDBAABDDA	0.00033	0.97249	GHFDBBBADDA	0.00041	0.96610
GHBBABABADA	0.00045	0.96330	GFADBAABDDA	0.00033	0.97282	DHABACABBCA	0.00041	0.96651
DHEAECAAABB	0.00044	0.96374	GDDDBAAADDA	0.00033	0.97315	GDDCAAABBDA	0.00041	0.96692
GDDDBAABDDA	0.00044	0.96418	FHACABABCCA	0.00033	0.97348	GHFCABAAADA	0.00040	0.96733
GDCCFADADDA	0.00042	0.96461	GHEBCBAACDA	0.00032	0.97380	DDDCCAAABCA	0.00039	0.96772
GHEBCBABBDA	0.00042	0.96503	GDCCCADBADA	0.00031	0.97411	GDCCFADADDA	0.00039	0.96811
GDCCAADBADA	0.00040	0.96543	GHFDBBAADDA	0.00031	0.97442	GFADBAABDDA	0.00038	0.96849
FGADBAABDCA	0.00040	0.96583	GHDDBBAADDA	0.00031	0.97473	GHFCABABBDA	0.00038	0.96887
DGACCAAABCA	0.00039	0.96622	GHADBAABDDA	0.00031	0.97503	CGADBCAADCB	0.00038	0.96925
GFADBAABDDA	0.00039	0.96661	EHADBCAADBB	0.00030	0.97533	GDDBAAABCDA	0.00037	0.96962
FHDDBBAADCA	0.00038	0.96699	GHBBABABADA	0.00030	0.97563	GHEBABABBDA	0.00037	0.96998
FHFDBBAADCA	0.00038	0.96737	FDDCAAABCCA	0.00029	0.97592	FHACABABACA	0.00036	0.97034
GHEBABABBDA	0.00038	0.96776	DHACDCBBDBB	0.00029	0.97620	DFACACABAAA	0.00036	0.97070
DHABDCBADBB	0.00037	0.96813	GDDCBAAADDB	0.00029	0.97649	GDCDBADADDA	0.00035	0.97105
GHFCABABBDA	0.00037	0.96850	DHEBDCBBDBB	0.00028	0.97677	GHADBAABDDA	0.00034	0.97139
GHFCABAACDA	0.00037	0.96886	GHBBABAABDA	0.00028	0.97705	DHABDCBADBB	0.00034	0.97173
GHACABAABDB	0.00036	0.96923	DAEAECAAABB	0.00028	0.97733	EHADBCAADBB	0.00033	0.97206
GHFDBBBADDA	0.00035	0.96958	GDDCAAAABDA	0.00027	0.97760	DHACCAAABCA	0.00033	0.97239
FDDBAAAACCA	0.00035	0.96994	FHEBBBABDCA	0.00027	0.97787	GDCBFADBDDA	0.00033	0.97272
CFADBCABDCA	0.00035	0.97029	GHFCABAACDA	0.00027	0.97813	GDDBBAAADDA	0.00033	0.97304
DHAADCBADBB	0.00035	0.97064	GHFCABABBDA	0.00026	0.97839	GDDDBAABDDA	0.00032	0.97336
GHADBAABDDA	0.00035	0.97099	FDDCBAABDCA	0.00025	0.97864	GDDCAAAAADA	0.00032	0.97367
DAFDDABBDBB	0.00034	0.97133	GHBBABABCDA	0.00025	0.97889	FGADBAABDCA	0.00031	0.97398
FHADBAABDCA	0.00034	0.97167	DHACDCBADBB	0.00025	0.97914	GHEBABABCDA	0.00031	0.97429
FHFCABAACCA	0.00033	0.97200	GHEBCBABBDA	0.00025	0.97940	FHBBABAABCA	0.00031	0.97460
FDDCAAAAACB	0.00033	0.97233	GDCCBADADDA	0.00025	0.97964	DHACDCBBDBB	0.00031	0.97491
GDDCBAAADDA	0.00032	0.97265	GHFCCBABADA	0.00024	0.97989	DFABACABBCA	0.00031	0.97521
FFADBAABDCB	0.00032	0.97297	GDDBAAABCDA	0.00024	0.98013	FGABBAAADCA	0.00030	0.97551
GDDDBAAADDA	0.00032	0.97329	CFADBCAADCB	0.00024	0.98037	GDDCCAABADA	0.00028	0.97579
GDCBAADBBDA	0.00031	0.97360	FHEBCBAACCA	0.00024	0.98061	EHACACABBCB	0.00028	0.97607
FGABBAAADCA	0.00031	0.97390	FHDDBBAADCA	0.00024	0.98085	GHACCBAACDB	0.00028	0.97635
DHACDCBBDBB	0.00028	0.97418	FHFDBBAADCA	0.00024	0.98109	DAEAECAAABB	0.00028	0.97663
DHEBDCBBDBB	0.00028	0.97447	GDDCAAAACDA	0.00023	0.98132	DHEBDBBADBB	0.00028	0.97690
GDDBAAABCDA	0.00028	0.97475	FHFCABAACCA	0.00022	0.98154	FHADBAABDCA	0.00028	0.97718
DAEAECAAABB	0.00028	0.97503	DFACACAAAAA	0.00022	0.98176	GHFDBBABDDA	0.00027	0.97745
GDCCBADADDB	0.00028	0.97531	GHACABAAADB	0.00022	0.98198	GHDDBBABDDA	0.00027	0.97772
DGABACABBCA	0.00028	0.97558	GDDCAAABCDB	0.00022	0.98220	GHFCCBABBDA	0.00026	0.97798
FHBBBBABDCA	0.00028	0.97586	GHFDBBBADDA	0.00022	0.98242	DHEBDCBBDBB	0.00026	0.97824
CHADBCABDCB	0.00027	0.97613	FDDBCAAABCA	0.00021	0.98264	GDDCAAABCDB	0.00026	0.97849
GHFCCBABBDA	0.00026	0.97640	GHEBCBAABDA	0.00021	0.98285	FDDBAAAACCA	0.00025	0.97875
DHAAECAACBB	0.00026	0.97665	GGADBAABDDA	0.00021	0.98305	FHEBABABCCA	0.00025	0.97900
BHADDCBBDBB	0.00026	0.97691	GHFDBBABDDA	0.00020	0.98325	FHACABAABCA	0.00025	0.97925
FDDBAAAABCA	0.00025	0.97716	GHDDBBABDDA	0.00020	0.98345	GDDDBAAADDA	0.00024	0.97948
DDDCCAAABCA	0.00025	0.97741	GHACBBAADDB	0.00020	0.98364	GGADBAABDDA	0.00024	0.97972
GHBBABABCDA	0.00025	0.97766	DHABDCBBDBB	0.00019	0.98383	GDCCBADADDA	0.00024	0.97996
GGADBAABDDA	0.00024	0.97790	FHBBABABCCA	0.00019	0.98402	FDDBBAABDCA	0.00023	0.98018
GHFCCBABADA	0.00024	0.97814	DDCCCADABCA	0.00019	0.98421	DFACACAAAAA	0.00022	0.98041
GDDCAAABCDB	0.00023	0.97838	GDDBBABADDA	0.00018	0.98439	DFBBACABBCA	0.00022	0.98063
GHFDBBABDDA	0.00023	0.97861	DGACACAAAAA	0.00018	0.98458	FDDCAAAAACB	0.00022	0.98085
GHDDBBABDDA	0.00023	0.97884	DDDCCAABACA	0.00017	0.98475	FFADBAABDCB	0.00022	0.98107

FDDBBAABDCA	0.00023	0.97906	DFACCAAABCA	0.00017	0.98492	DAEBDABADBB	0.00022	0.98129
GHACABABCDA	0.00022	0.97928	CHADBBAADCB	0.00017	0.98508	GDCCAADBADA	0.00022	0.98150
GDDCAAAAADA	0.00022	0.97950	DAFDDABADBB	0.00016	0.98525	DHACCBAABCA	0.00022	0.98172
GDDCAAAACDA	0.00022	0.97972	FDDCBAABDCB	0.00016	0.98541	GHACBBAADDB	0.00022	0.98194
FHBBABAABCA	0.00021	0.97993	GDCCAADACDB	0.00016	0.98557	FHACCBAACCB	0.00021	0.98215
DAEBDABADBB	0.00021	0.98014	GDCBAADBADA	0.00015	0.98572	GHBBCBAACDA	0.00021	0.98236
FHACABABACA	0.00021	0.98035	GDCBCADABDA	0.00015	0.98588	FHDDBBABDCA	0.00020	0.98256
GDDCCAABADA	0.00021	0.98056	FHDDBBABDCA	0.00015	0.98603	FHFDBBABDCA	0.00020	0.98276
DHACCAAABCA	0.00021	0.98076	FHFDBBABDCA	0.00015	0.98618	FHACCBABACA	0.00020	0.98297
DHABDCBBDBB	0.00020	0.98096	FHBBABAAACA	0.00015	0.98632	FHDDBBABDCB	0.00020	0.98317
FDDDBABBDCB	0.00020	0.98116	FDDCAAABCCB	0.00015	0.98647	GHEBCBABBDA	0.00020	0.98337
GDDCAAAABDA	0.00020	0.98135	GDDCCAAACDA	0.00015	0.98662	DAFCDABBDBB	0.00020	0.98356
GHACCBAACDB	0.00019	0.98155	FFABBAAADCA	0.00015	0.98677	FHACABAABCB	0.00019	0.98376
DHEBDBBADBB	0.00019	0.98174	FHACBBAADCB	0.00015	0.98691	GHFDBBBBDDA	0.00019	0.98395
DAFCDABBDBB	0.00019	0.98193	GDDDBABBDDB	0.00015	0.98706	GHACABABCDA	0.00019	0.98414
FHBBABABCCA	0.00019	0.98212	GDDBCAAACDA	0.00015	0.98721	GHBBBBABBDA	0.00019	0.98433
DGACACAAAAA	0.00018	0.98231	FFADBAABDCA	0.00015	0.98735	GHACBBAADDA	0.00019	0.98452
GHEBCBAABDA	0.00018	0.98249	GHFDBBBBDDA	0.00014	0.98749	DHABDCBBDBB	0.00018	0.98471
FHBBABAAACA	0.00018	0.98267	FDDBBAABDCA	0.00014	0.98763	FHBBABAAACA	0.00018	0.98488
GHACABAAADB	0.00018	0.98285	DHAADCBADBB	0.00014	0.98777	GHFCCBAACDA	0.00018	0.98506
GHACBBAADDB	0.00017	0.98302	GHFCCBABBDA	0.00013	0.98790	FHACBBAADCB	0.00016	0.98522
FDDDBABBDCA	0.00017	0.98320	FDDCCAAACCA	0.00013	0.98803	FDDDBABBDCB	0.00016	0.98539
FHDDBBABDCA	0.00017	0.98337	GHDBBBAADDA	0.00013	0.98816	GDCCBADBDDA	0.00016	0.98555
FHFDBBABDCA	0.00017	0.98354	GDCBAADBBDA	0.00013	0.98829	DHACDBBADBB	0.00016	0.98571
FHACABABCCA	0.00017	0.98371	GFACAAABADA	0.00013	0.98842	GHDDBBAADDB	0.00016	0.98587
GHFDBBBBDDA	0.00016	0.98387	FHADBAABDCA	0.00013	0.98855	FHBBABABACA	0.00016	0.98603
GHFCABAAADA	0.00016	0.98403	GDCCCADACDB	0.00013	0.98868	EHADBCABDCB	0.00016	0.98619
GDDCAAAACDB	0.00016	0.98419	DHEBDBBADBB	0.00012	0.98880	FDDDBABBDCA	0.00016	0.98635
GHFCCBAACDA	0.00016	0.98435	GDDCBAAADDA	0.00012	0.98892	FHBBCBAACCA	0.00016	0.98650
GHACBBAADDA	0.00016	0.98451	GDDCBABBDDA	0.00012	0.98904	GHACABAAADB	0.00016	0.98666
FHDDBBABDCB	0.00015	0.98466	GDCCCADABDB	0.00012	0.98916	GHFDBBAADDB	0.00016	0.98681
FGADBAABDCB	0.00015	0.98482	DHFCCBABACA	0.00012	0.98927	GHDBBBAADDA	0.00015	0.98697
CFADBCAADCB	0.00015	0.98497	DAFDDABBDBB	0.00011	0.98939	GHACABAACDB	0.00015	0.98711
DDCCCADBACA	0.00015	0.98512	FHACABABACA	0.00011	0.98950	GDDCAAAACDA	0.00015	0.98726
CDDCBAAADCA	0.00015	0.98526	DHFCCBAABCA	0.00011	0.98961	FHACABABCCA	0.00014	0.98740
FHACCBAACCB	0.00015	0.98541	DFBBACABABA	0.00011	0.98972	FHACBBAADCA	0.00014	0.98755
FDDCAAABCCB	0.00015	0.98555	GHACABAABDB	0.00011	0.98983	GHFCABABADA	0.00014	0.98769
DHFCCBABACA	0.00015	0.98570	DHBBABAAABA	0.00011	0.98993	GHDCABAACDA	0.00014	0.98783
GFABAAAACDA	0.00015	0.98585	DAFAECAACBB	0.00010	0.99003	GDDCCAABBDA	0.00013	0.98796
GHBBCBAACDA	0.00014	0.98599	GDDCAAABADA	0.00010	0.99014	FHFCCBAACCA	0.00013	0.98810
GHDBBBAADDA	0.00014	0.98613	GFADBAAADDA	0.00010	0.99024	FHFDBBBADCA	0.00013	0.98823
GDDCCAABBDA	0.00014	0.98627	FDDCBAAADCA	0.00010	0.99034	GDDCAAAACDB	0.00013	0.98836
FHBBABABACA	0.00014	0.98642	FHDBBBAADCA	0.00010	0.99044	DFBBACABABA	0.00013	0.98849
GHBBBBABBDA	0.00014	0.98656	DHEBACABBCA	0.00010	0.99053	FHFCABAAACA	0.00013	0.98861
GDCCAADBBDB	0.00014	0.98670	GDDCAAAABDB	0.00010	0.99063	GDDBCAAACDA	0.00013	0.98874
GHDDBBAADDB	0.00014	0.98683	FHBBABABACA	0.00009	0.99072	GHDBABAABDA	0.00012	0.98887
GDDCBAAADDB	0.00014	0.98697	GDDDBABADDB	0.00009	0.99082	FHDDBBAADCB	0.00012	0.98899
GDDBBABADDA	0.00013	0.98711	GHEBBBBADDA	0.00009	0.99091	FHFCABABBCA	0.00012	0.98911
FHEBCBABBCA	0.00013	0.98724	GHACABABCDB	0.00009	0.99100	FHFDBBAADCB	0.00012	0.98923
FHACBBAADCB	0.00013	0.98737	GHDDBBAADDB	0.00009	0.99109	DHBBABAABCA	0.00012	0.98935
FHBBCBABBCA	0.00013	0.98750	EHADBCAADBA	0.00009	0.99118	FHDBBBAADCA	0.00012	0.98946
DFBBACABABA	0.00013	0.98763	GHFCCBAACDA	0.00009	0.99127	EHADBCAADBA	0.00012	0.98958
EHADBCAADBB	0.00013	0.98775	FDDCAAAACCA	0.00009	0.99136	GFABAAAACDA	0.00012	0.98970
GHFDBBAADDB	0.00013	0.98788	FHBBABAABCA	0.00009	0.99145	GDDCBAAADDA	0.00012	0.98981
GHACABABCDB	0.00013	0.98801	FGADBAABDCA	0.00009	0.99154	FHEBABABBCA	0.00012	0.98993
GDDBCAAACDA	0.00012	0.98813	GHACCBAACDB	0.00009	0.99162	GDDCBABBDDB	0.00012	0.99004
GDCCCADACDA	0.00012	0.98825	FHBBCBABBCA	0.00009	0.99171	DHACABAAACA	0.00011	0.99016
GHACABAACDB	0.00012	0.98838	DFABACABABA	0.00008	0.99179	GHDCABAAADA	0.00011	0.99027
FHEBABABBCA	0.00012	0.98850	GFACAAAACDA	0.00008	0.99188	DADDDABBDBB	0.00011	0.99038
DHABACABBCA	0.00012	0.98862	GHFDBBAADDB	0.00008	0.99196	GHFDBBBADDB	0.00011	0.99049
FHFCCBAACCA	0.00012	0.98874	FHFCABABBCA	0.00008	0.99204	FHACABAACCB	0.00011	0.99060
FHACBBAADCA	0.00012	0.98885	FHEBCBABBCA	0.00008	0.99212	GDDBBABBDDA	0.00011	0.99071
FDDBAAAAACA	0.00012	0.98897	DHABDCBADBB	0.00008	0.99220	GHEBBBABDDA	0.00011	0.99082
FHFCABABBCA	0.00012	0.98909	GDDBCAABBDA	0.00008	0.99227	GDCCCADACDB	0.00011	0.99093
GDDDBABBDDB	0.00012	0.98920	DHACACABACB	0.00008	0.99235	GHEBBBBADDA	0.00011	0.99104
FHACABAABCB	0.00012	0.98932	FHFCCBABACA	0.00008	0.99243	GDCCAADABDA	0.00011	0.99115
GDDCBABBDDB	0.00011	0.98943	FFADBCAADCB	0.00008	0.99251	FGADBAABDCB	0.00011	0.99126
GFACAAABADA	0.00011	0.98954	FHDDBBABDCB	0.00007	0.99258	GHACABABCDB	0.00011	0.99136
FHFDBBBADCA	0.00011	0.98966	DGACCAAABCA	0.00007	0.99266	FHDCABAACCA	0.00011	0.99147

GDCCAADABDB	0.00011	0.98977	GDDCCAABADA	0.00007	0.99273	GHDDBBBADDA	0.00010	0.99157
GHDCABAACDA	0.00011	0.98988	GHDCABAACDA	0.00007	0.99280	CFADBCAADCB	0.00010	0.99167
FHDBBBAADCA	0.00011	0.98998	GHEBABABBDA	0.00007	0.99288	DFABACABABA	0.00010	0.99177
FHBBCBAACCA	0.00011	0.99009	GHFCABAAADA	0.00007	0.99295	FDDCAAABCCB	0.00010	0.99187

APPENDIX C

PARTIAL OUTPUT FOR FRACTIONAL CONTRIBUTION ANALYSIS FOR METHOD 2

This appendix contains some of the output generated for a fractional contribution analysis of the Surry plant based on Method 2 of Section 4, which computes the fractional contribution to the average risk. A brief explanation of the output contained in this appendix is as follows:

Page(s)	
C-2	The top of the page echoes the files used in the analysis along with characteristics of the files. The bottom portion of the page contains the fractional contribution to the average risk by plant damage state for each consequence measure. Note that each of the nine columns in this analysis will total to 1.
C-3	This page contains the fractional contribution to the average risk by source term group for each consequence measure. The groups used in this analysis were defined by the PARTITION program. Note that each of the nine columns in this analysis will total to 1.
C-4 to C-5	These pages contain the fractional contribution to the average risk by accident progression bin characteristic for each of the 11 attributes used to classify the accident progression bins (see page 13 of the user's guide). This analysis is broken down by the type of consequence. Note that each of the 11 columns will total to 1 for a given consequence measure.
C-6 to C-7	These pages contain the fractional contribution to the average risk by accident progression bin characteristic for each of the nine consequence measures. This analysis is broken down by the 11 attributes used to classify the accident progression bins. Note that each of the nine columns will total to 1 for a given attribute.
C-8 to C-9	These pages contain the fractional contribution to the average risk by accident progression bin for each of the nine consequence measures. Two numbers appear under each column that is headed by a consequence measure. The first number in a given row is the contribution corresponding to the accident progression bin identified in that row and the second number is the cumulative total as one goes down the column. Note the accident progression bins in each column appear in decreasing order based on the magnitude of their contribution. The printout continues until each of the three measures totals at least .99. The printout for the remaining six consequences has been omitted to save space.

<> <> PRA MODEL INTEGRATION SYSTEM - SNLA (JUNE 1989) <> <>

SURRY - FRACTIONAL CONTRIBUTION TO THE AVERAGE RISK

SMP [RLIMAN.PRAMIS]LHS.DAT

PDS [RLIMAN.PRAMIS]PDS.DAT

MBL [RLIMAN.PRAMIS]MBL.DAT

APB [RLIMAN.PRAMIS]APB.DAT

PAR [RLIMAN.PRAMIS]PAR.DAT

CSQ [RLIMAN.PRAMISCSQS.DAT

NAM FRACON

FRC GBL

END CSQ

```
  200 SAMPLES
   11-CHARACTER BIN ID DESCRIPTORS
    7 OF     7 PLANT DAMAGE STATES SPECIFIED
 1906 OF  1906 ACCIDENT PROGRESSION BINS SPECIFIED
   52 OF    52 SOURCE TERM PARTITIONS SPECIFIED
    9 OF     9 CONSEQUENCE MEASURES SPECIFIED
```

MATRIX MULTIPLICATIONS WILL BE TERMINATED FOLLOWING COMPUTATION OF CSQ

FRACTIONAL CONTRIBUTIONS OF PDS TO CSQ

	CSQ								
	1	2	3	4	5	6	7	8	9
MEAN RISK=	2.0E-06	3.0E-05	9.0E-09	5.2E-03	5.8E-02	3.1E-01	2.1E+04	1.6E-08	1.7E-09
PDS									
1	0.08570	0.01533	0.11624	0.10923	0.14813	0.10972	0.10248	0.11158	0.19292
2	0.00032	0.00010	0.00043	0.01340	0.02313	0.01356	0.00796	0.00064	0.01975
3	0.08549	0.00920	0.12155	0.04580	0.06069	0.04571	0.04937	0.11492	0.10522
4	0.77277	0.93627	0.70434	0.34272	0.36347	0.34565	0.36537	0.71377	0.49342
5	0.00055	0.00044	0.00061	0.00369	0.00399	0.00368	0.00339	0.00075	0.00314
6	0.01376	0.00398	0.01825	0.02038	0.02107	0.02025	0.02097	0.01820	0.02394
7	0.04141	0.03466	0.03858	0.46479	0.37952	0.46144	0.45046	0.04014	0.16161

FRACTIONAL CONTRIBUTIONS OF PAR TO CSQ

	CSQ 1	CSQ 2	CSQ 3	CSQ 4	CSQ 5	CSQ 6	CSQ 7	CSQ 8	CSQ 9
MEAN RISK=	2.0E-06	3.0E-05	9.0E-09	5.2E-03	5.8E-02	3.1E-01	2.1E+04	1.6E-08	1.7E-09
PAR									
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.00000	0.00000	0.00000	0.00001	0.00002	0.00001	0.00000	0.00000	0.00002
3	0.00359	0.03036	0.00875	0.00138	0.00394	0.00133	0.00019	0.01472	0.01500
4	0.00000	0.00000	0.00000	0.00001	0.00001	0.00001	0.00001	0.00000	0.00001
5	0.00432	0.00013	0.00391	0.00223	0.00295	0.00215	0.00354	0.00352	0.01282
6	0.00651	0.04635	0.01639	0.01368	0.02629	0.01354	0.00841	0.02635	0.03421
7	0.00001	0.00000	0.00001	0.00013	0.00020	0.00014	0.00017	0.00001	0.00007
8	0.00418	0.00018	0.00575	0.00604	0.00771	0.00610	0.00986	0.00544	0.01745
9	0.05809	0.22160	0.14534	0.11218	0.14343	0.11298	0.11731	0.19608	0.15263
10	0.00007	0.00003	0.00021	0.03987	0.03582	0.03932	0.02876	0.00032	0.01339
11	0.00001	0.00004	0.00000	0.01537	0.02137	0.01523	0.01250	0.00005	0.01400
12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00098	0.00012	0.00140	0.00047	0.00060	0.00042	0.00058	0.00123	0.00155
15	0.08723	0.10638	0.09898	0.04659	0.04284	0.04811	0.06098	0.09248	0.04839
16	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
17	0.00022	0.00019	0.00015	0.00216	0.00194	0.00215	0.00236	0.00061	0.00199
18	0.05235	0.06704	0.05846	0.02938	0.02591	0.02962	0.03081	0.05709	0.03871
19	0.00109	0.00043	0.00050	0.01512	0.01575	0.01509	0.02360	0.00040	0.00214
20	0.19223	0.01908	0.27359	0.06145	0.06692	0.06067	0.08646	0.25724	0.17627
21	0.03372	0.06949	0.06612	0.03583	0.03357	0.03554	0.03175	0.07291	0.04552
22	0.00054	0.00034	0.00105	0.05811	0.03987	0.05789	0.04912	0.00091	0.01041
23	0.00111	0.00155	0.00073	0.03634	0.03078	0.03589	0.03063	0.00620	0.01777
24	0.00002	0.00006	0.00004	0.00004	0.00004	0.00004	0.00003	0.00005	0.00005
25	0.00024	0.00012	0.00064	0.04981	0.03666	0.04934	0.03810	0.00064	0.01083
26	0.00008	0.00010	0.00015	0.02031	0.02351	0.02006	0.01673	0.00029	0.01374
27	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
28	0.00077	0.00148	0.00004	0.00168	0.00151	0.00161	0.00316	0.00003	0.00017
29	0.00213	0.00205	0.00223	0.00150	0.00139	0.00145	0.00242	0.00238	0.00184
30	0.27271	0.15435	0.10215	0.03211	0.02626	0.03235	0.03739	0.08059	0.04779
31	0.00488	0.00655	0.00053	0.02243	0.02137	0.02138	0.03534	0.00042	0.00249
32	0.00492	0.01076	0.00016	0.02879	0.01447	0.02880	0.03869	0.00014	0.01210
33	0.25857	0.24064	0.20812	0.07153	0.06119	0.07213	0.07851	0.17350	0.11112
34	0.00598	0.00961	0.00143	0.06541	0.04677	0.06572	0.07893	0.00116	0.00849
35	0.00093	0.00774	0.00068	0.02211	0.01521	0.02212	0.02486	0.00275	0.00962
36	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
37	0.00176	0.00254	0.00137	0.06899	0.04442	0.06848	0.06756	0.00114	0.01043
38	0.00010	0.00015	0.00016	0.00104	0.00071	0.00103	0.00090	0.00051	0.00039
39	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
40	0.00071	0.00054	0.00098	0.05380	0.03429	0.05333	0.04431	0.00083	0.00909
41	0.00000	0.00000	0.00000	0.00001	0.00001	0.00001	0.00001	0.00000	0.00000
42	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00003	0.00011	0.00004	0.00075	0.00000	0.00002
44	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
45	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
46	0.00000	0.00000	0.00000	0.00034	0.00139	0.00054	0.00095	0.00000	0.00038
47	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
48	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
49	0.00000	0.00000	0.00000	0.06984	0.14770	0.07176	0.02701	0.00000	0.14018
50	0.00000	0.00000	0.00000	0.01388	0.02305	0.01363	0.00733	0.00002	0.01894
51	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
52	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 1

CSQ 1 RISK= 2.0E-06

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.48458	0.00134	0.92869	0.00770	0.18551	0.04329	0.93532	0.72184	0.17211	0.00216	0.84290
B	0.28819	0.00000	0.00580	0.04303	0.78010	0.01603	0.01286	0.27815	0.00625	0.04673	0.15709
C	0.00012	0.00000	0.05182	0.14507	0.00490	0.94067	0.00000		0.01214	0.38976	
D	0.17261	0.04124	0.00650	0.80420	0.01258		0.05182		0.80950	0.56135	
E	0.00001	0.00000	0.00544		0.00009						
F	0.00641	0.13007	0.00175		0.01682						
G	0.04808	0.02390									
H		0.80345									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 2

CSQ 2 RISK= 3.0E-05

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.39314	0.00033	0.96895	0.00042	0.03830	0.01909	0.97424	0.79753	0.02744	0.00465	0.97107
B	0.54313	0.00000	0.00255	0.01710	0.94041	0.02162	0.00816	0.20247	0.00819	0.01272	0.02893
C	0.00008	0.00000	0.01760	0.03022	0.00544	0.95929	0.00000		0.00812	0.35385	
D	0.02810	0.01854	0.00302	0.95226	0.00796		0.01760		0.95625	0.62878	
E	0.00001	0.00000	0.00698		0.00001						
F	0.00651	0.01536	0.00089		0.00788						
G	0.02904	0.00335									
H		0.96241									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 3

CSQ 3 RISK= 9.0E-09

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.31046	0.00180	0.91326	0.00875	0.24802	0.05511	0.91416	0.61974	0.23446	0.00018	0.78052
B	0.39388	0.00000	0.00654	0.05160	0.71019	0.00674	0.01736	0.38026	0.00411	0.06165	0.21948
C	0.00017	0.00000	0.06847	0.19679	0.00359	0.93815	0.00000		0.01317	0.41778	
D	0.23601	0.05244	0.00800	0.74286	0.01706		0.06847		0.74826	0.52039	
E	0.00003	0.00000	0.00169		0.00012						
F	0.00468	0.18142	0.00204		0.02100						
G	0.05478	0.03336									
H		0.73097									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 4

CSQ 4 RISK= 5.2E-03

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.12252	0.01081	0.72100	0.01101	0.26339	0.10788	0.85925	0.62872	0.15046	0.01594	0.79898
B	0.22020	0.00000	0.03397	0.15067	0.58799	0.38674	0.04289	0.37128	0.08664	0.06244	0.20102
C	0.00095	0.00000	0.09786	0.21769	0.05695	0.50538	0.00000		0.08330	0.37088	
D	0.12980	0.11874	0.03914	0.62063	0.03761		0.09786		0.67960	0.55073	
E	0.00764	0.00000	0.08147		0.00006						
F	0.18700	0.08344	0.02655		0.05400						
G	0.33188	0.02235									
H		0.76465									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 5

CSQ 5 RISK= 5.8E-02

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.10873	0.01223	0.72991	0.01554	0.23980	0.10459	0.86231	0.61863	0.14153	0.00937	0.75677
B	0.25474	0.00000	0.02971	0.13462	0.62436	0.30337	0.04043	0.38137	0.07441	0.06402	0.24323
C	0.00109	0.00000	0.09726	0.19025	0.04660	0.59204	0.00000		0.07051	0.42253	
D	0.12744	0.13136	0.05120	0.65960	0.03590		0.09726		0.71355	0.50408	
E	0.01350	0.00000	0.06869		0.00006						
F	0.21434	0.11837	0.02322		0.05329						
G	0.28017	0.03209									
H		0.70595									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 6

CSQ 6 RISK= 3.1E-01

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.12394	0.01069	0.72287	0.01103	0.26137	0.10690	0.86041	0.62960	0.14923	0.01596	0.79919
B	0.22170	0.00000	0.03374	0.14935	0.59133	0.38407	0.04249	0.37040	0.08615	0.06164	0.20081
C	0.00094	0.00000	0.09711	0.21626	0.05639	0.50903	0.00000		0.08244	0.37209	
D	0.12817	0.11832	0.03932	0.62336	0.03723		0.09711		0.68218	0.55031	
E	0.00776	0.00000	0.08065		0.00006						
F	0.18757	0.08362	0.02632		0.05363						
G	0.32991	0.02250									
H		0.76488									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 7

CSQ 7 RISK= 2.1E+04

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.13853	0.00901	0.72204	0.01408	0.29553	0.10948	0.85804	0.63222	0.19028	0.02020	0.81167
B	0.22684	0.00000	0.03412	0.16090	0.55648	0.37263	0.04080	0.36778	0.08546	0.07168	0.18833
C	0.00076	0.00000	0.10116	0.23117	0.05784	0.51789	0.00000		0.07770	0.35430	
D	0.16213	0.11291	0.03061	0.59385	0.03638		0.10116		0.64656	0.55382	
E	0.00378	0.00000	0.08878		0.00007						
F	0.14582	0.08417	0.02328		0.05370						
G	0.32213	0.02222									
H		0.77170									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 8

CSQ 8 RISK= 1.6E-08

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.27249	0.00237	0.91232	0.00825	0.23476	0.05759	0.91094	0.61656	0.22080	0.00022	0.78790
B	0.44128	0.00000	0.00611	0.04977	0.71945	0.00582	0.01973	0.38344	0.00418	0.06132	0.21210
C	0.00023	0.00000	0.06933	0.18639	0.00343	0.93659	0.00000		0.01333	0.41948	
D	0.22467	0.05496	0.00827	0.75560	0.01940		0.06933		0.76169	0.51897	
E	0.00003	0.00000	0.00146		0.00012						
F	0.00439	0.17069	0.00251		0.02283						
G	0.05690	0.03152									
H		0.74046									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ 9

CSQ 9 RISK= 1.7E-09

APB ATTRIBUTES

	1	2	3	4	5	6	7	8	9	10	11
A	0.16887	0.00855	0.81225	0.03214	0.24884	0.09923	0.87000	0.59556	0.19869	0.00539	0.72066
B	0.32455	0.00000	0.01405	0.07920	0.65630	0.09400	0.03095	0.40444	0.03550	0.08197	0.27933
C	0.00081	0.00000	0.09905	0.18889	0.02001	0.80677	0.00000		0.03476	0.44927	
D	0.20418	0.12258	0.04381	0.69978	0.02863		0.09905		0.73105	0.46336	
E	0.01165	0.00000	0.01942		0.00010						
F	0.14042	0.19290	0.01142		0.04612						
G	0.14952	0.04673									
H		0.62923									

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ
APB ATTRIBUTE 1
CSQ

	1	2	3	4	5	6	7	8	9
A	0.48458	0.39314	0.31046	0.12252	0.10873	0.12394	0.13853	0.27249	0.16887
B	0.28819	0.54313	0.39388	0.22020	0.25474	0.22170	0.22684	0.44128	0.32455
C	0.00012	0.00008	0.00017	0.00095	0.00109	0.00094	0.00076	0.00023	0.00081
D	0.17261	0.02810	0.23601	0.12980	0.12744	0.12817	0.16213	0.22467	0.20418
E	0.00001	0.00001	0.00003	0.00764	0.01350	0.00776	0.00378	0.00003	0.01165
F	0.00641	0.00651	0.00468	0.18700	0.21434	0.18757	0.14582	0.00439	0.14042
G	0.04808	0.02904	0.05478	0.33188	0.28017	0.32991	0.32213	0.05690	0.14952

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ
APB ATTRIBUTE 2
CSQ

	1	2	3	4	5	6	7	8	9
A	0.00134	0.00033	0.00180	0.01081	0.01223	0.01069	0.00901	0.00237	0.00855
B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
C	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
D	0.04124	0.01854	0.05244	0.11874	0.13136	0.11832	0.11291	0.05496	0.12258
E	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
F	0.13007	0.01536	0.18142	0.08344	0.11837	0.08362	0.08417	0.17069	0.19290
G	0.02390	0.00335	0.03336	0.02235	0.03209	0.02250	0.02222	0.03152	0.04673
H	0.80345	0.96241	0.73097	0.76465	0.70595	0.76488	0.77170	0.74046	0.62923

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ
APB ATTRIBUTE 3
CSQ

	1	2	3	4	5	6	7	8	9
A	0.92869	0.96895	0.91326	0.72100	0.72991	0.72287	0.72204	0.91232	0.81225
B	0.00580	0.00255	0.00654	0.03397	0.02971	0.03374	0.03412	0.00611	0.01405
C	0.05182	0.01760	0.06847	0.09786	0.09726	0.09711	0.10116	0.06933	0.09905
D	0.00650	0.00302	0.00800	0.03914	0.05120	0.03932	0.03061	0.00827	0.04381
E	0.00544	0.00698	0.00169	0.08147	0.06869	0.08065	0.08878	0.00146	0.01942
F	0.00175	0.00089	0.00204	0.02655	0.02322	0.02632	0.02328	0.00251	0.01142

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ
APB ATTRIBUTE 4
CSQ

	1	2	3	4	5	6	7	8	9
A	0.00770	0.00042	0.00875	0.01101	0.01554	0.01103	0.01408	0.00825	0.03214
B	0.04303	0.01710	0.05160	0.15067	0.13462	0.14935	0.16090	0.04977	0.07920
C	0.14507	0.03022	0.19679	0.21769	0.19025	0.21626	0.23117	0.18639	0.18889
D	0.80420	0.95226	0.74286	0.62063	0.65960	0.62336	0.59385	0.75560	0.69978

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ
APB ATTRIBUTE 5
CSQ

	1	2	3	4	5	6	7	8	9
A	0.18551	0.03830	0.24802	0.26339	0.23980	0.26137	0.29553	0.23476	0.24884
B	0.78010	0.94041	0.71019	0.58799	0.62436	0.59133	0.55648	0.71945	0.65630
C	0.00490	0.00544	0.00359	0.05695	0.04660	0.05639	0.05784	0.00343	0.02001
D	0.01258	0.00796	0.01706	0.03761	0.03590	0.03723	0.03638	0.01940	0.02863
E	0.00009	0.00001	0.00012	0.00006	0.00006	0.00006	0.00007	0.00012	0.00010
F	0.01682	0.00788	0.02100	0.05400	0.05329	0.05363	0.05370	0.02283	0.04612

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ
APB ATTRIBUTE 6
CSQ

	1	2	3	4	5	6	7	8	9
A	0.04329	0.01909	0.05511	0.10788	0.10459	0.10690	0.10948	0.05759	0.09923
B	0.01603	0.02162	0.00674	0.38674	0.30337	0.38407	0.37263	0.00582	0.09400
C	0.94067	0.95929	0.93815	0.50538	0.59204	0.50903	0.51789	0.93659	0.80677

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ

APB ATTRIBUTE 7

CSQ

	1	2	3	4	5	6	7	8	9
A	0.93532	0.97424	0.91416	0.85925	0.86231	0.86041	0.85804	0.91094	0.87000
B	0.01286	0.00816	0.01736	0.04289	0.04043	0.04249	0.04080	0.01973	0.03095
C	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
D	0.05182	0.01760	0.06847	0.09786	0.09726	0.09711	0.10116	0.06933	0.09905

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ

APB ATTRIBUTE 8

CSQ

	1	2	3	4	5	6	7	8	9
A	0.72184	0.79753	0.61974	0.62872	0.61863	0.62960	0.63222	0.61656	0.59556
B	0.27815	0.20247	0.38026	0.37128	0.38137	0.37040	0.36778	0.38344	0.40444

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ

APB ATTRIBUTE 9

CSQ

	1	2	3	4	5	6	7	8	9
A	0.17211	0.02744	0.23446	0.15046	0.14153	0.14923	0.19028	0.22080	0.19869
B	0.00625	0.00819	0.00411	0.08664	0.07441	0.08615	0.08546	0.00418	0.03550
C	0.01214	0.00812	0.01317	0.08330	0.07051	0.08244	0.07770	0.01333	0.03476
D	0.80950	0.95625	0.74826	0.67960	0.71355	0.68218	0.64656	0.76169	0.73105

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ

APB ATTRIBUTE 10

CSQ

	1	2	3	4	5	6	7	8	9
A	0.00216	0.00465	0.00018	0.01594	0.00937	0.01596	0.02020	0.00022	0.00539
B	0.04673	0.01272	0.06165	0.06244	0.06402	0.06164	0.07168	0.06132	0.08197
C	0.38976	0.35385	0.41778	0.37088	0.42253	0.37209	0.35430	0.41948	0.44927
D	0.56135	0.62878	0.52039	0.55073	0.50408	0.55031	0.55382	0.51897	0.46336

FRACTIONAL CONTRIBUTIONS OF APB ATTRIBUTES TO CSQ

APB ATTRIBUTE 11

CSQ

	1	2	3	4	5	6	7	8	9
A	0.84290	0.97107	0.78052	0.79898	0.75677	0.79919	0.81167	0.78790	0.72066
B	0.15709	0.02893	0.21948	0.20102	0.24323	0.20081	0.18833	0.21210	0.27933

FRACTIONAL CONTRIBUTIONS OF APB TO CSQ

CSQ 1			CSQ 2			CSQ 3		
AHADBCAADDA	0.25815	0.25815	BHADBCAADDA	0.29439	0.29439	BHADBCAADDA	0.22800	0.22800
BHADBCAADDA	0.19203	0.45018	AHADBCAADDA	0.20109	0.49548	AHADBCAADDA	0.15861	0.38661
AHADBCAADCA	0.16086	0.61104	BHADBCAADCA	0.15199	0.64747	DFACACABACB	0.14483	0.53144
DFACACABACB	0.10176	0.71280	AHADBCAADCA	0.11937	0.76684	BHADBCAADCA	0.10463	0.63607
BHADBCAADCA	0.06975	0.78255	BHADBCABDDA	0.05658	0.82342	AHADBCAADCA	0.08785	0.72392
AHADBCABDDA	0.04639	0.82894	AHADBCABDDA	0.04769	0.87111	AHADBCABDDA	0.04158	0.76550
DGACACABACB	0.01862	0.84756	BHADBCABDCA	0.03781	0.90892	BHADBCABDDA	0.03742	0.80292
AHADBCABDCA	0.01796	0.86552	AHADBCABDCA	0.02353	0.93245	DGACACABACB	0.02650	0.82942
BHADBCABDDA	0.01671	0.88223	DFACACABACB	0.01010	0.94255	BHADBCABDCA	0.02231	0.85173
DFCBACDBABA	0.01539	0.89762	GDCDFADBDDB	0.00309	0.94564	DFCBACDBABA	0.02191	0.87364
GDCDFADBDDB	0.00965	0.90726	DFACACABAAA	0.00232	0.94796	AHADBCABDCA	0.02114	0.89477
BHADBCABDCA	0.00907	0.91633	BHADDCBADBB	0.00218	0.95014	GDCDFADBDDB	0.01286	0.90763
DHADDCBBDBB	0.00817	0.92451	DGACACABACB	0.00185	0.95199	DHADDCBBDBB	0.01144	0.91907
GDCDFADBDDA	0.00398	0.92849	DHADDCBBDBB	0.00162	0.95361	DFBBACABABA	0.00548	0.92455
DFAAACAAABA	0.00392	0.93241	DHADDCBADBB	0.00158	0.95519	GDCDFADBDDA	0.00492	0.92946
DFBBACABABA	0.00385	0.93626	GDCDFADBDDA	0.00156	0.95675	GDCCAADAADB	0.00485	0.93432
GDCCAADAADB	0.00341	0.93967	DFCBACDBABA	0.00153	0.95827	GDCBAADAADA	0.00435	0.93867
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APPENDIX D

PARTIAL LISTING OF THE INPUT FILES REQUIRED BY PRAMIS

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         9               7  2.3247007E-05  1.2373655E-06  3.0553185E-06
 2.0985244E-07  2.1136630E-06  2.5623342E-07  2.7551603E-06
     .
     .
     .
       196               7  9.7856455E-06  7.1458676E-06  1.8151096E-06
 3.4669831E-08  8.6748099E-07  1.1980208E-08  2.4646383E-06
       197               7  1.6884764E-05  2.6259404E-06  5.1315324E-06
 7.7293251E-08  8.6340560E-07  7.4661801E-07  1.0297254E-06
       198               7  3.0836502E-06  5.2383202E-06  2.6870453E-07
 2.8128045E-11  7.1563761E-07  7.5523499E-06  2.7108069E-06
       199               7  2.2002303E-06  3.1932725E-06  1.9871939E-06
 3.4402231E-07  9.2297050E-08  3.0688241E-07  1.6960391E-06
       200               7  9.6117747E-06  4.5237089E-06  9.0195101E-07
 4.7667186E-06  6.0028106E-07  3.7139416E-06  1.7932731E-06
```

MBL FILE:

```
SURRY LHS BASE MASTER BINS, NOTBYOBS, 19 FEB 89

        11       1906
AHADBCAADCA
AHADBCAADDA
AHADBCABDCA
AHADBCABDDA
AHADDCBADBB
AHADDCBBDBB
BHADBCAADCA
BHADBCAADDA
     .
     .
     .
GHFDBBABDDA
GHFDBBABDDB
GHFDBBBADDA
GHFDBBBADDB
GHFDBBBBDDA
GHFDBBBBDDB
```

APB FILE:

```
   Surry Rebinning - Rev. 4 - 11 Feb 89 - Over all Base Case PDSG's
    11     200        7
     1       1       43  2.0865E-05
CCDCAFCDADCA   2.1138E-05
CCDCDFCDADCA   6.4329E-05
   .
   .
   .
GGHADBCAADDA   1.6804E-03
GGHADBCAADDB   2.9571E-03
     1       2       18  1.8407E-05
CCDCDBCDADCB   3.4835E-05
CCDCDFCDADCA   9.0587E-05
   .
   .
   .
GGDDDBCBADDA   2.3756E-03
GGDDDBCBADDB   1.4385E-02
     1       3       31  7.1542E-06
CCDCDFCDADCA   3.9664E-05
CCDCDFCDADCB   6.4187E-05
   .
   .
   .
GGHADBCAADDA   2.1080E-04
GGHADBCAADDB   3.4113E-04
     1       4        6  2.7872E-08
AAHADBCAADCA   1.6864E-02
AAHADBCAADDA   2.2344E-02
AAHADDCBADBB   2.3838E-04
BBHADBCAADCA   4.1065E-01
BBHADBCAADDA   5.4410E-01
BBHADDCBADBB   5.8060E-03
     1       5       17  1.2077E-06
CCDCAACDABCA   5.9091E-05
CCDCDFCDADCB   1.1348E-04
   .
   .
   .
GGDDDBCAADDB   1.7620E-02
GGDDDBCBADDB   2.9758E-03
     1       6       28  2.0883E-05
CCDCDBCDADCB   7.2421E-05
CCDCDFCDADCB   6.1290E-05
   .
   .
   .
GGDDDBCBADDA   1.0913E-03
GGDDDBCBADDB   3.0049E-02
     1       7       35  1.3228E-06
CCDCDFADADCA   7.3310E-05
CCHADBBAADCA   1.0665E-04
   .
   .
   .
GGHFDBBBADDA   1.1124E-03
GGHFDBBBADDB   1.5270E-05
     2       1       40  2.1406E-05
CCDCBFCDBDCA   7.2931E-05
CCDCDFCDBDCB   8.4881E-05
   .
   .
   .
GGHBBCCAABDA   1.2698E-05
GGHEBCCAABDA   5.0790E-05
   .
```

```
    .
    .
    200        1        30  9.6118E-06
CCDCCFCDBDCA   1.8754E-05
CCDCDFCDBDCB   1.1149E-04
    .
    .
    .
GGHACBCABDDA   4.1222E-03
GGHADBCABDDB   2.0002E-02
    200        2        16  4.5237E-06
CCDCCBCDBDCA   1.6679E-05
CCDCDBCDBDCB   5.4114E-05
    .
    .
    .
GGDDDBCABDDB   1.3251E-01
GGDDDBCBBDDB   2.2379E-02
    200        3        28  9.0195E-07
CCDCCFCDBDCA   7.2986E-05
CCDCDFCDBDCB   3.5643E-05
    .
    .
    .
GGHACBCABDDA   1.3696E-03
GGHADBCABDDB   6.6882E-04
    200        4         4  4.7667E-06
AAHADBCABDCA   3.4241E-02
AAHADBCABDDA   4.5368E-02
BBHADBCABDCA   3.9587E-01
BBHADBCABDDA   5.2452E-01
    200        5        10  6.0028E-07
CCDCDBCDBDCB   1.1499E-05
CCDCDFCDBDCB   1.7999E-04
    .
    .
    .
GGDDDBCABDDB   2.8117E-02
GGDDDBCBBDDB   4.7487E-03
    200        6        14  3.7139E-06
CCDCDBCDBDCB   8.5120E-05
CCDCDFCDBDCB   4.5597E-05
    .
    .
    .
GGDDDBCABDDB   2.0884E-01
GGDDDBCBBDDB   3.5271E-02
    200        7        31  1.7933E-06
CCHACBBABDCA   1.6267E-04
FFDDCBAABDCA   8.0115E-03
    .
    .
    .
GGHFDBBABDDB   3.5293E-04
GGHFDBBBBDDB   2.5097E-04
```

PAR FILE:

PARTITION SUBGROUP POINTERS

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18	15	0	0	18	0	6	6	0	0	9	0	0	50	0	0	0	0	0	47
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	11	0	0	0	50
50	0	0	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	50	50	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

.
.
.

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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	49	0	0	0	46	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	49	0	0	0	46	0	0	0	0	0	0	0	0	0	0	0
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0	0	0	0	0	0	0	0	0	0	0	49	0	0	0	49	0	0	0	0
0	0	0	0	0	0	0	0	49	0	0	0	49	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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0	0	0	0	49	0	0	0	49	0	0	0	0	0	0	0	0	0	0	0
0	49	0	0	0	49														

CSQ FILE:

```
SURRY CONSEQUENCES (52 PARTITIONS, 9 CONSEQUENCES)
     52          9
SUR 1-2
 0.00E+00
 0.00E+00
 0.00E+00
 0.00E+00
 0.00E+00
 0.00E+00
 3.63E+05
 0.00E+00
 0.00E+00
SUR 2-2
 9.35E-05
 1.25E-03
 3.26E-07
 9.31E+01
 2.33E+03
 5.73E+03
 1.25E+08
 4.64E-06
 6.52E-05
    .
    .
    .
SUR51-2
 0.00E+00
 0.00E+00
 0.00E+00
 0.00E+00
 0.00E+00
 0.00E+00
 3.63E+05
 0.00E+00
 0.00E+00
SUR52-2
 0.00E+00
 0.00E+00
 0.00E+00
 0.00E+00
 0.00E+00
 0.00E+00
 0.00E+00
 0.00E+00
 0.00E+00
```

NRC FORM 335
(2-89)
NRCM 1102,
3201, 3202

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

1. REPORT NUMBER (Assigned by NRC. Add Vol., Supp., Rev., and Addendum Numbers, if any.)

NUREG/CR-5262

SAND88-3093

2. TITLE AND SUBTITLE

PRAMIS: Probability Risk Assessment Model Integration System

User's Guide

3. DATE REPORT PUBLISHED

MONTH	YEAR
May	1990

4. FIN OR GRANT NUMBER

A1393

5. AUTHOR(S)

Ronald L. Iman, Jay D. Johnson, Jon C. Helton

6. TYPE OF REPORT

Technical

7. PERIOD COVERED *(Inclusive Dates)*

8. PERFORMING ORGANIZATION — NAME AND ADDRESS *(If NRC, provide Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)*

Sandia National Laboratories
Albuquerque, NM 87185-5800

9. SPONSORING ORGANIZATION — NAME AND ADDRESS *(If NRC, type "Same as above"; if contractor, provide NRC Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address.)*

Division of Risk Analysis and Operations
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555

10. SUPPLEMENTARY NOTES

11. ABSTRACT *(200 words or less)*

This document has been designed for users of the Probabilistic Risk Assessment Model Integration System (PRAMIS) computer program developed by the authors at Sandia National Laboratories for easy assembly of the individual parts of the NUREG-1150 plant analyses into overall risk results. PRAMIS assembles the following files associated with the NUREG-1150 analyses in matrix format to obtain risk: the Latin hypercube sample, the results of the systems analysis, the results of the accident progression analysis, the results of the source term/partitioning analysis, and the results of the consequence analysis. In addition, various intermediate and conditional quantities are calculated when requested by user-specified input; the fractional contribution to risk of individual plant damage states, accident progression bins and source term groups are determined, and a file containing the original Latin hypercube sample and user-specified dependent variables is generated for use as input to the SAS statistical package. This report provides a tutorial that details how to use the PRAMIS program. The PRAMIS program is written in ANSI standard FORTRAN 77 to make the code as machine-independent (that is, portable) as possible.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

Latin Hypercube Sample, Plant Damage States, Accident Progression Bins, Source Term Groups

PRAMIS

13. AVAILABILITY STATEMENT

Unlimited

14. SECURITY CLASSIFICATION

(This Page)

Unclassfied

(This Report)

Unclassfied

15. NUMBER OF PAGES

16. PRICE