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DETERMINATION OF DOSE DISTRIBUTIONS AND PARAMETER SENSITIVITY

Hanford Environmental Dose Reconstruction Project
Dose Code Recovery Activities
- Calculation 005

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PREFACE

This report documents one of a series of scoping calculations performed as part of the dose code recovery activities for the Hanford Environmental Dose Reconstruction Project. These scoping calculations form a mutually-dependent set that build upon each other, and each is best read in the context of the others. The complete list of scoping reports is given below.

Title	Calculation Number
Scoping Calculation for Components of the Cow-Milk Dose Pathway for Evaluating the Dose Contribution from Iodine-131	001
Determination of the Contribution of Livestock Water Ingestion to Dose from the Cow-Milk Pathway	002
Determination of Radionuclides and Pathways Contributing to Dose in 1945	003
Determination of Radionuclides and Pathways Contributing to Cumulative Dose	004
Determination of Dose Distributions and Parameter Sensitivity	005
Determination of the Feasibility of Reducing the Spatial Domain of the HEDR Dose Code	006
Determination of the Spatial Resolution Required for the HEDR Dose Code	007
Determination of the Temporal Resolution Required for the HEDR Dose Code	008

Additional scoping calculations are in progress or planned, and each will be documented in similar project reports.

CONTENTS

TABLES

1.0 INTRODUCTION

A series of scoping calculations has been undertaken to evaluate the absolute and relative contribution of different radionuclides and exposure pathways to doses that may have been received by individuals living in the vicinity of the Hanford site. These scoping calculations may include some radionuclides and pathways included in the Phase I air-pathway dose evaluations, as well as other potential exposure pathways being evaluated for possible inclusion in the future Hanford Environmental Dose Reconstruction (HEDR) modeling efforts.

This scoping calculation (Calculation 005) examined the contributions of numerous parameters to the uncertainty distribution of doses calculated for environmental exposures and accumulation in foods. This study builds on the work initiated in the first scoping study of iodine in cow's milk and the third scoping study, which added additional pathways. Addressed in this calculation were the contributions to thyroid dose of infants from 1) air submersion and groundshine external dose, 2) inhalation, 3) ingestion of soil by humans, 4) ingestion of leafy vegetables, 5) ingestion of other vegetables and fruits, 6) ingestion of meat, 7) ingestion of eggs, and 8) ingestion of cows' milk from Feeding Regime 1 as described in Calculation 001.

Recommendations determined from scoping calculations are provided to the HEDR Technical Steering Panel (TSP) with the intent of providing a definitive technical basis to assist in deciding whether specific radionuclides and exposure pathways should or should not be included in the HEDR dose estimation process for individuals. This scoping calculation is intended to support the information provided in Calculations 001 (components of the milk pathway), 003 (contributions of additional pathways), 004 (temporal distribution of cumulative dose), and later calculations of the spatial distribution of contamination.

2.0 TECHNICAL METHODS

Thyroid doses were calculated for a highly exposed infant in a highly exposed area and time period (the 1945 Franklin County node used in earlier calculations), using the spreadsheet developed for Calculation 003. Individuals were assumed to have a rural lifestyle, with milk supplied by a backyard cow supported on Feeding Regime 1 (HEDR staff 1991, page 2.17). Parameters in the initial calculations were selected to be approximate average, median, or best-estimate values, rather than conservative, upper bound values. In the analysis for Calculation 005, the single-point, deterministic values were replaced with the distributions intended for use in the final dose code (Snyder et al. 1992).

Surface deposition and integrated air concentration data used were not Phase I values. Rather, they were recalculated (J. V. Ramsdell, Jr., data transmittal, October 1992) using the RATCHET atmospheric dispersion code (Ramsdell and Burk 1992) based upon the latest Hanford iodine-131 source term information reported by Heeb (Heeb 1992, page 4.36). Because of time constraints, monthly surface deposition and integrated air concentrations from a single realization were used in these scoping calculations (J. V. Ramsdell Jr., data transmittal, October, 1992). Recent results from Ramsdell indicate that the particular realization used is, for all months, well within a factor of two of the maximums of the 100 realizations ultimately planned to be used for this particular location. Therefore, this realization is considered to be a conservative, but reasonable, representation of this location (J.V. Ramsdell, Jr., personal communication, November 1992).

2.1 CALCULATION OF DOSE RANGES

The case simulated was that of an infant drinking milk from a backyard cow that was being fed on Feeding Regime 1. A stochastic simulation was performed using the commercial sensitivity/uncertainty software package Crystal Ball® (Decisioneering 1992). The Crystal Ball® software allows Monte Carlo evaluation of relatively complex input spreadsheets, by performing repetitive solutions of the spreadsheet with varying input parameters. Twenty parameters, listed in Table 1, were allowed to vary over the ranges described

TABLE 1. Parameters Varied in Stochastic Analysis

Parameter	Nominal Value	Distribution Type
TF_{milk_ind}	9.2E-3 d/L	lognormal
IR_{milk}	0.8 L/d	triangular
DF_{ing}	1.4E+7 rad/Ci	lognormal
TF_{beef}	0.03 d/kg	uniform
$Mass_{bale}$	30 kg	uniform
R_{v_cow}	9 kg/d	triangular
TF_{egg}	4.75 d/kg	uniform
DF_{ext}	3.1E+3 rad/mo per Ci/m^2	uniform
DF_{inh}	1.1E+7 rad/Ci	lognormal
IR_{soil}	0.001 kg/d	uniform
BR_{infant}	1.88E-5 m^3/s	triangular
DF_{imm}	0.24 rad/s per Ci/m^3	uniform
f_{trans}	0.05 (unitless)	loguniform
R_{p_lf}	2.3E-3 kg/d	triangular
R_{p_ov}	3.45E-2 kg/d	triangular
$R_{p\text{-}beef}$	4.5E-2 kg/d	triangular
$R_{p\text{-}egg}$	5.0E-3 kg/d	triangular
$R_{v\text{-}Chicken}$	5.0E-2 kg/d	uniform
$FS_{chicken}$	0.001 kg/d	uniform
$\lambda_{weather}$	0.05 d^{-1}	triangular

in Snyder et al (1992). Appendix A provides complete details of the overall range and distributional shapes and the complete Crystal Ball® output. A total of 500 realizations of the spreadsheet were made.

2.2 SENSITIVITY ANALYSIS

The Crystal Ball® software has limited capabilities for performing sensitivity analyses. It allows for one or more of the input variables to be set to a nominal value and the entire calculation to be redone. Initial analysis of the output indicated to the authors that it was likely that the overall uncertainty distribution being calculated was dominated by only a few parameters. Two parameters appeared to be controlling the uncertainty distribution: the ingestion dose factor (DF_{ing}) and the feed-to-milk transfer factor ($TF_{milk\text{-}ind}$). These were set to their mean values and the problem rerun. The results of this simple analysis are presented in Appendix B.

2.3 RESULT VERIFICATION

As part of the dose-code recovery activities, a prototype implementation of the full set of required equations has been made. This prototype code, called PILOT, is still in development, and has not yet completed the required Quality Assurance testing and documentation; results must be considered to come from unverified software. However, the developers are now reasonably comfortable with its results. This prototype code was used to reproduce the spreadsheet scenario used in Calculation 003 and in this scoping study.

Results from the PILOT code corresponded favorably with those produced using the Crystal Ball® software. For the same location, the PILOT code gave results at the 5th, 25th, 50th, 75th, and 95th percentiles that were essentially one-half those given by Crystal Ball®. Because the single atmospheric transport realization used in the spreadsheet calculation was shown to be near the maximum of the 100 RATCHET realizations, and because the PILOT code is using all 100 realizations, this is a reasonable difference. Results of the PILOT code analysis are given in Appendix C.

A regression analysis made on the PILOT code doses indicated that the ingestion dose factor and feed-to-milk transfer factor, combined, accounted for approximately 80% of the observed variability in the calculated dose. This acts to support the results derived with the simpler spreadsheet

calculations. This PILOT code information is further elaborated in Calculation 007.

3.0 RESULTS/DISCUSSION

The results of calculations are presented in detail in Appendices A, B, and C. Summaries of the total dose are given in Table 2. It can be seen from the table that the deterministic doses used in Calculations 001, 003, and 004 are essentially the mean values, as desired. This affirms the usefulness of the results of these calculations, as intended by this calculation.

The Crystal Ball® results also show that the final dose distribution is essentially lognormally distributed, and has a substantial range. Results obtained by setting only the ingestion dose factor and feed-to-milk transfer factor to mean values show greatly reduced ranges, indicating that a large portion of the uncertainty is due to these two parameters. Preliminary sensitivity results from the PILOT prototype code show the same magnitude, range, and key parameters.

The two controlling input parameters require additional discussion. Both of these two inputs have been assigned lognormal distributions, and both distributions have geometric standard deviations (GSDs) of 2.0. The (potentially infinite) lognormal distributions were truncated at the 0.1 and 99.9 percentiles in this analysis. For distributions with a GSD of 2.0, approximately 65% of the distribution is within a factor of 1/2 to 2 of the nominal value. This distributional assumption is quite good for the

Table 2. Summary of Calculated Results for Various Calculational Cases (rad to infant thyroid)

Value	Deterministic	Fully-Stochastic	With 2 Fixed Parameters
Mean	605	595	666
Median		359	652
Mode		83	507
5 percentile		63	416
95 percentile		2011	973

central values, but it implies that the overall range at the 0.1 and 99.9 percentiles is over two orders-of-magnitude--that is, that the upper value is more than 100 times larger than the lower value.

The lognormal distribution was selected for only a few parameters input to the environmental accumulation and dose models--in part because it indicates that a very large range is possible for those parameters. There is a possibility that the assignment of this distributional shape is untowardly influencing the entire result. Because the GSD of 2.0, as well as the lognormal shape itself, was imposed on the parameters, this sensitivity analysis indicates that these selections should be reviewed.

The forgoing discussion should not be construed to indicate that the HEDR staff is attempting to "make the input parameters fit an assumed answer." The iterative nature of the planned calculations--where a result is computed, analyzed, and revised--has been a part of the HEDR Project from the beginning. This approach is designed to focus the activities on data collection and parameter refinement, which together will provide the greatest benefit in finalizing an answer. This analysis has discovered parameters that are greatly influencing the result. The input parameters should, therefore, be reanalyzed; but they should only be changed if convincing arguements can be made that they need to be.

4.0 RECOMMENDATIONS

Scoping calculations were performed to determine, first, the reasonableness of the deterministic values used in Calculations 001, 003, and 004, and, second, to determine the largest contributors to the variabilty of the dose distribution. Based on the results of this scoping study, and the companion studies on dose, the following recommendations are made for the HEDR Project:

- The values calculated in the initial scoping studies should be interpreted as mean or average results. The actual dose distributions are not known, but they may be considered to be fairly broad.
- The distributional assumptions made in Snyder et al. (1992) for the dose factors and feed-to-milk transfer factors should be revisited to determine if the lognormal distribution is appropriate. In addition, truncation limits other than at the 0.1 and 99.9 percentiles should be considered for all potentially infinite input variables (lognormal, normal, loguniform).

5.0 QUALITY ASSURANCE

Quality assurance was undertaken in accordance with PNL-MA-70, Volume 1, Procedures for Quality Assurance Program, under PNL administrative procedure PAP-70-301, "Hand Calculations, General." Complete documentation of the calculations was prepared by the senior author, who independently prepared the calculational spreadsheets and performed the spreadsheet calculations. A thorough independent review was conducted by a senior scientist independent of the HEDR Project. Spreadsheet documentation is on file and available for review.

6.0 REFERENCES

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Snyder, S. F., W. T. Farris, B. A. Napier, T. A. Ikenberry, and R. O. Gilbert. 1992. Parameters Used in the Environmental Pathways (DESCARTES) and Radiological Dose (CIDER) Modules of the Hanford Environmental Dose Reconstruction Integrated Codes (HEDRIC) for the Air Pathway. PNWD-2023 HEDR, Battelle, Pacific Northwest Laboratories, Richland, Washington.

APPENDIX A

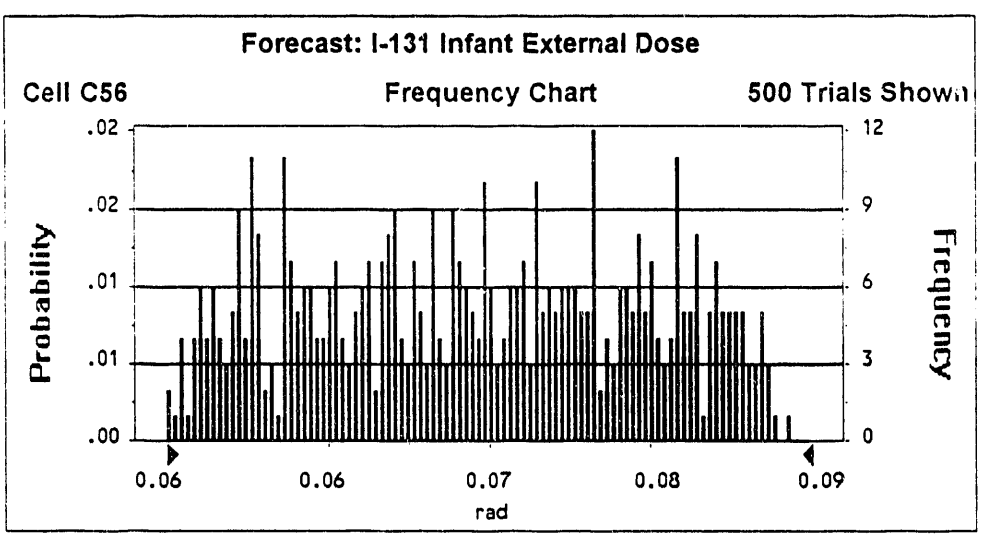
REPORT OF STOCHASTIC SIMULATION OF INDIVIDUAL INFANT DOSE FROM IODINE-131 RELEASES IN 1945

Crystal Ball Report
Simulation started on 12/3/92 at 10:40:14
Simulation stopped on 12/3/92 at 10:46:43

Forecast: I-131 Infant External Dose **Cell: C56**

Summary:
Display Range is from 0.06 to 0.09 rad
Entire Range is from 0.06 to 0.08 rad
After 500 Trials, the Std. Error of the Mean is 0.00

Statistics:	Display Range	Entire Range
Trials	500	500
Mean	0.07	0.07
Median	0.07	0.07
Mode	0.06	0.06
Standard Deviation	0.01	0.01
Variance	0.00	0.00
Skewness	0.00	0.00
Kurtosis	1.84	1.84
Coeff. of Variability	0.10	0.10
Range Minimum	0.06	0.06
Range Maximum	0.09	0.08
Range Width	0.03	0.03
Mean Std. Error	0.00	0.00



Forecast: I-131 Infant External Dose (cont'd) **Cell: C56**

Percentiles for Entire Range (rad):

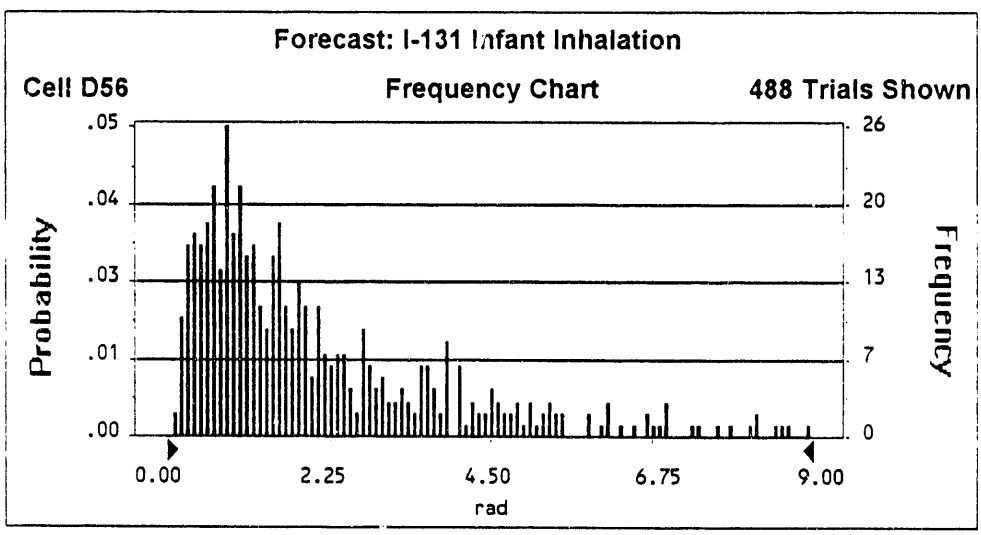
Percentile	I-131 Infant External Dose
0%	0.06
5%	0.06
25%	0.06
50%	0.07
75%	0.08
95%	0.08
100%	0.08

End of Forecast

Forecast: I-131 Infant Inhalation **Cell: D56**

Summary:
Display Range is from 0.00 to 9.00 rad
Entire Range is from 0.12 to 22.55 rad
After 500 Trials, the Std. Error of the Mean is 0.11

Statistics:	Display Range	Entire Range
Trials	488	500
Mean	2.10	2.35
Median	1.53	(unavailable)
Mode	0.59	(unavailable)
Standard Deviation	1.78	2.47
Variance	3.16	6.11
Skewness	1.52	(unavailable)
Kurtosis	5.10	(unavailable)
Coeff. of Variability	0.85	1.05
Range Minimum	0.00	0.12
Range Maximum	9.00	22.55
Range Width	9.00	22.42
Mean Std. Error	0.08	0.11



Forecast: I-131 Infant Inhalation (cont'd) **Cell: D56**

Percentiles for Entire Range (rad):

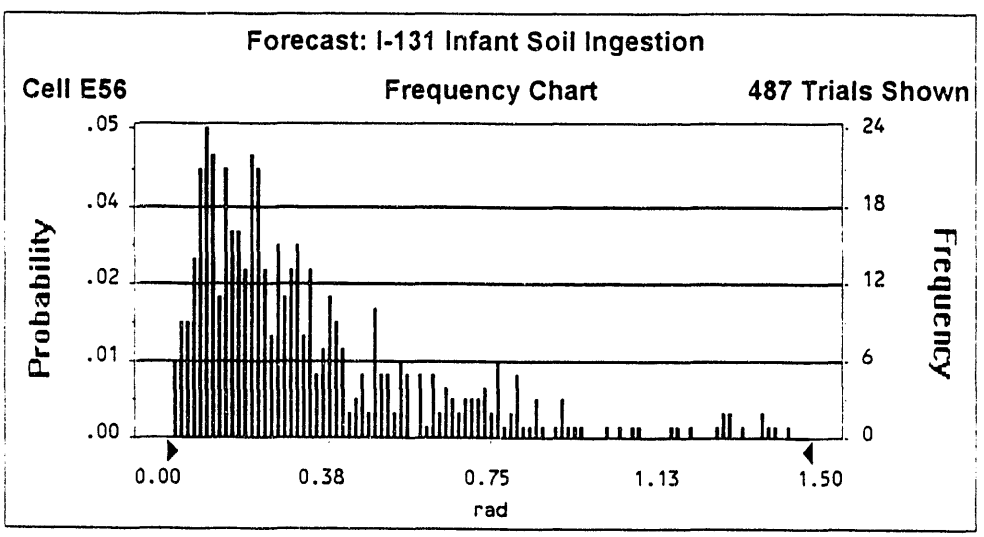
Percentile	I-131 Infant Inhalation
0%	0.12
5%	0.34
25%	0.85
50%	1.54
75%	2.98
95%	6.95
100%	22.55

End of Forecast

Forecast: I-131 Infant Soil Ingestion **Cell: E56**

Summary:
Display Range is from 0.00 to 1.50 rad
Entire Range is from 0.02 to 3.02 rad
After 500 Trials, the Std. Error of the Mean is 0.02

Statistics:	Display Range	Entire Range
Trials	487	500
Mean	0.34	0.38
Median	0.25	(unavailable)
Mode	0.08	(unavailable)
Standard Deviation	0.28	0.40
Variance	0.08	0.16
Skewness	1.62	(unavailable)
Kurtosis	5.66	(unavailable)
Coeff. of Variability	0.84	1.05
Range Minimum	0.00	0.02
Range Maximum	1.50	3.02
Range Width	1.50	3.00
Mean Std. Error	0.01	0.02



Forecast: I-131 Infant Soil Ingestion (cont'd) **Cell: E56**

Percentiles for Entire Range (rad):

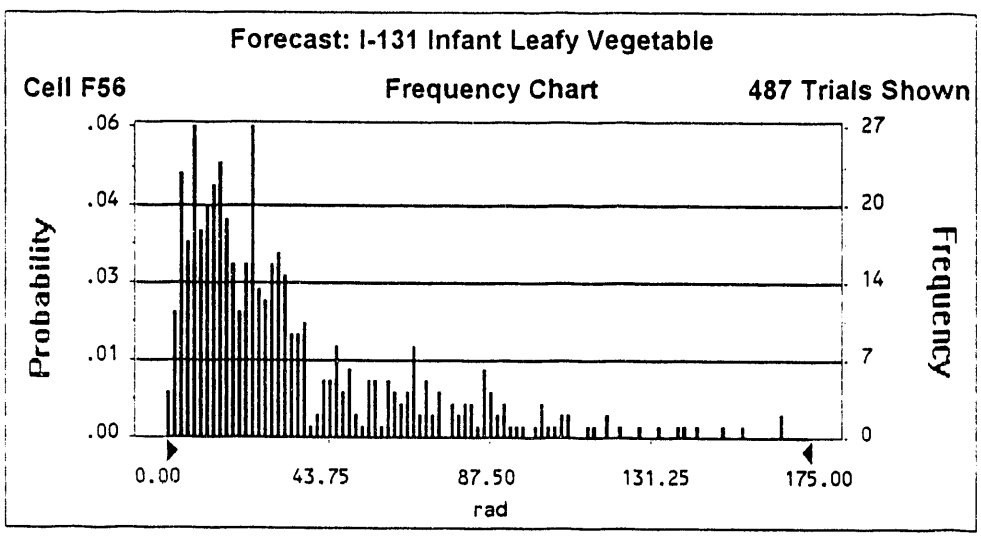
Percentile	I-131 Infant Soil Ingestion
0%	0.02
5%	0.06
25%	0.14
50%	0.26
75%	0.48
95%	1.20
100%	3.02

End of Forecast

Forecast: I-131 Infant Leafy Vegetable **Cell: F56**

Summary:
Display Range is from 0.00 to 175.00 rad
Entire Range is from 0.24 to 301.03 rad
After 500 Trials, the Std. Error of the Mean is 1.95

Statistics:	Display Range	Entire Range
Trials	487	500
Mean	33.96	38.87
Median	23.97	(unavailable)
Mode	7.29	(unavailable)
Standard Deviation	30.96	43.50
Variance	958.56	1892.62
Skewness	1.62	(unavailable)
Kurtosis	5.64	(unavailable)
Coeff. of Variability	0.91	1.12
Range Minimum	0.00	0.24
Range Maximum	175.00	301.03
Range Width	175.00	300.79
Mean Std. Error	1.40	1.95



Forecast: I-131 Infant Leafy Vegetable (cont'd) **Cell: F56**

Percentiles for Entire Range (rad):

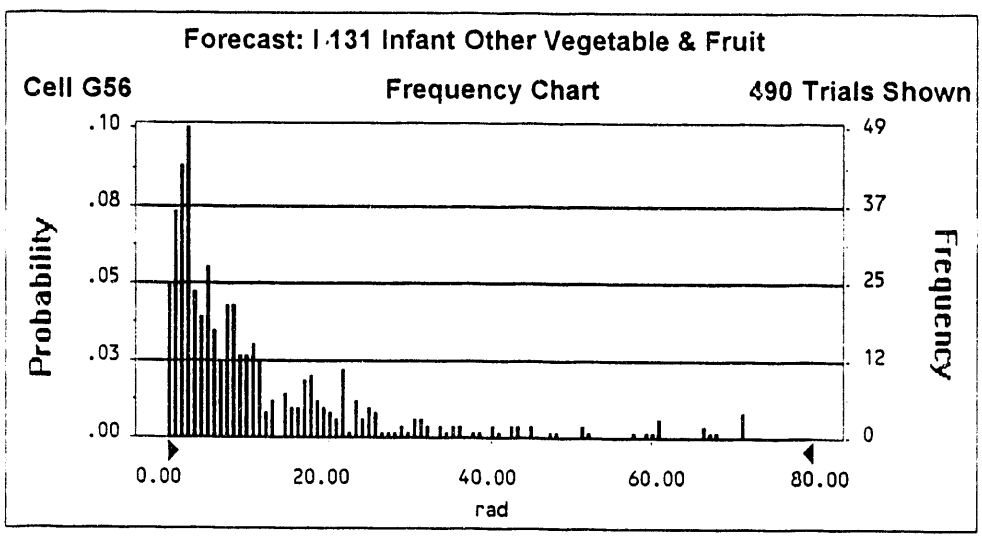
Percentile	I-131 Infant Leafy Vegetable
0%	0.24
5%	4.49
25%	12.60
50%	24.30
75%	48.36
95%	117.55
100%	301.03

End of Forecast

Forecast: I-131 Infant Other Vegetable & Fruit **Cell: G56**

Summary:
Display Range is from 0.00 to 80.00 rad
Entire Range is from 0.15 to 228.37 rad
After 500 Trials, the Std. Error of the Mean is 0.94

Statistics:	Display Range	Entire Range
Trials	490	500
Mean	11.73	13.81
Median	6.67	(unavailable)
Mode	2.53	(unavailable)
Standard Deviation	13.86	21.10
Variance	192.12	445.36
Skewness	2.23	(unavailable)
Kurtosis	8.36	(unavailable)
Coeff. of Variability	1.18	1.53
Range Minimum	0.00	0.15
Range Maximum	80.00	228.37
Range Width	80.00	228.22
Mean Std. Error	0.63	0.94



Forecast: I-131 Infant Other Vegetable & Fruit (cont'd) **Cell: G56**

Percentiles for Entire Range (rad):

Percentile	I-131 Infant Other Vegetable & Fruit
0%	0.15
5%	0.80
25%	2.76
50%	7.13
75%	16.99
95%	51.88
100%	228.37

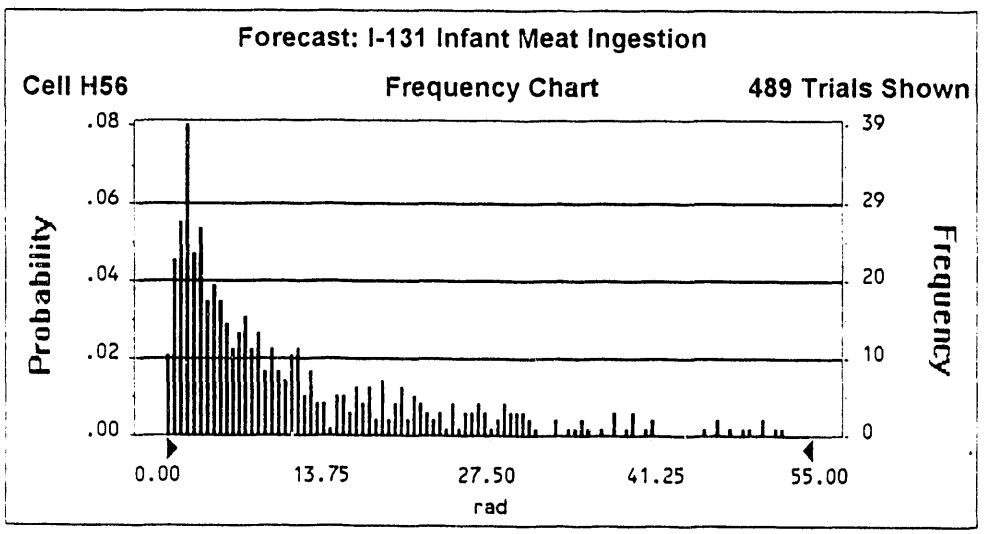
End of Forecast

Forecast: I-131 Infant Meat Ingestion **Cell: H56**

Summary:

Display Range is from 0.00 to 55.00 rad
Entire Range is from 0.23 to 135.58 rad
After 500 Trials, the Std. Error of the Mean is 0.70

Statistics:	Display Range	Entire Range
Trials	489	500
Mean	10.90	12.51
Median	6.86	(unavailable)
Mode	1.93	(unavailable)
Standard Deviation	11.05	15.67
Variance	122.05	245.70
Skewness	1.56	(unavailable)
Kurtosis	5.10	(unavailable)
Coeff. of Variability	1.01	1.25
Range Minimum	0.00	0.23
Range Maximum	55.00	135.58
Range Width	55.00	135.35
Mean Std. Error	0.50	0.70



Forecast: I-131 Infant Meat Ingestion (cont'd) **Cell: H56**

Percentiles for Entire Range (rad):

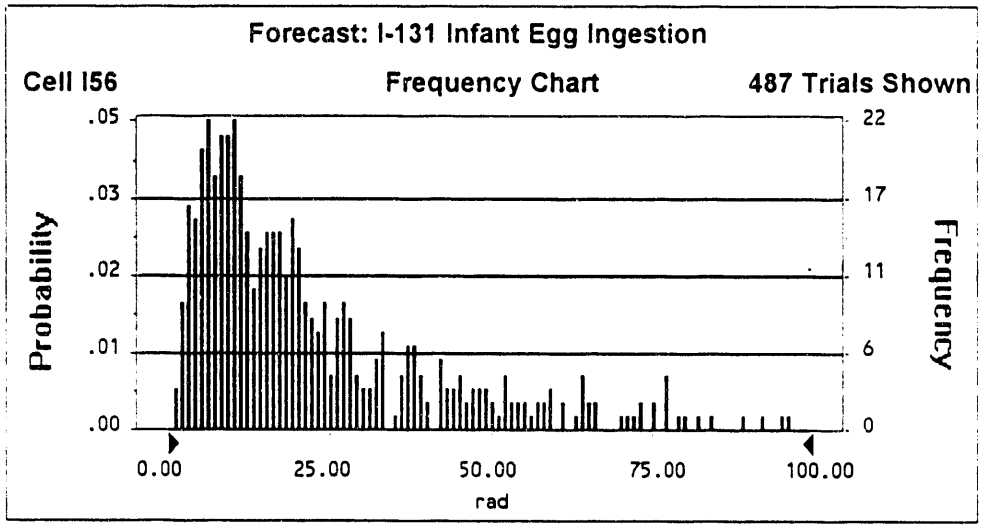
Percentile	I-131 Infant Meat Ingestion
0%	0.23
5%	0.91
25%	2.83
50%	7.00
75%	16.77
95%	39.78
1( )%	135.58

End of Forecast

Forecast: I-131 Infant Egg Ingestion **Cell: I56**

Summary:
Display Range is from 0.00 to 100.00 rad
Entire Range is from 1.43 to 216.38 rad
After 500 Trials, the Std. Error of the Mean is 1.26

Statistics:	Display Range	Entire Range
Trials	487	500
Mean	22.59	25.92
Median	16.47	(unavailable)
Mode	6.17	(unavailable)
Standard Deviation	19.11	28.20
Variance	365.26	795.35
Skewness	1.49	(unavailable)
Kurtosis	4.83	(unavailable)
Coeff. of Variability	0.85	1.09
Range Minimum	0.00	1.43
Range Maximum	100.00	216.38
Range Width	100.00	214.95
Mean Std. Error	0.87	1.26



Forecast: I-131 Infant Egg Ingestion (cont'd) **Cell: I56**

Percentiles for Entire Range (rad):

Percentile	I-131 Infant Egg Ingestion
0%	1.43
5%	3.79
25%	9.14
50%	17.07
75%	31.52
95%	75.94
100%	216.38

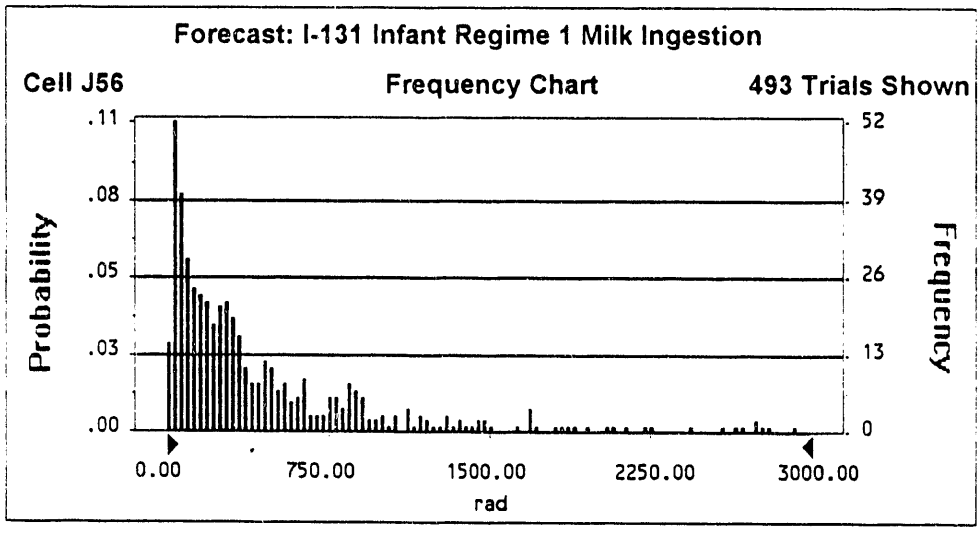
End of Forecast

Forecast: I-131 Infant Regime 1 Milk Ingestion **Cell: J56**

Summary:

Display Range is from 0.00 to 3000.00 rad
Entire Range is from 7.86 to 11712.56 rad
After 500 Trials, the Std. Error of the Mean is 37.59

Statistics:	Display Range	Entire Range
Trials	493	500
Mean	457.09	523.85
Median	272.86	(unavailable)
Mode	45.00	(unavailable)
Standard Deviation	529.45	840.61
Variance	280315.02	706632.82
Skewness	2.23	(unavailable)
Kurtosis	8.58	(unavailable)
Coeff. of Variability	1.16	1.60
Range Minimum	0.00	7.86
Range Maximum	3000.00	11712.56
Range Width	3000.00	11704.70
Mean Std. Error	23.85	37.59



Forecast: I-131 Infant Regime 1 Milk Ingestion (cont'd) **Cell: J56**

Percentiles for Entire Range (rad):

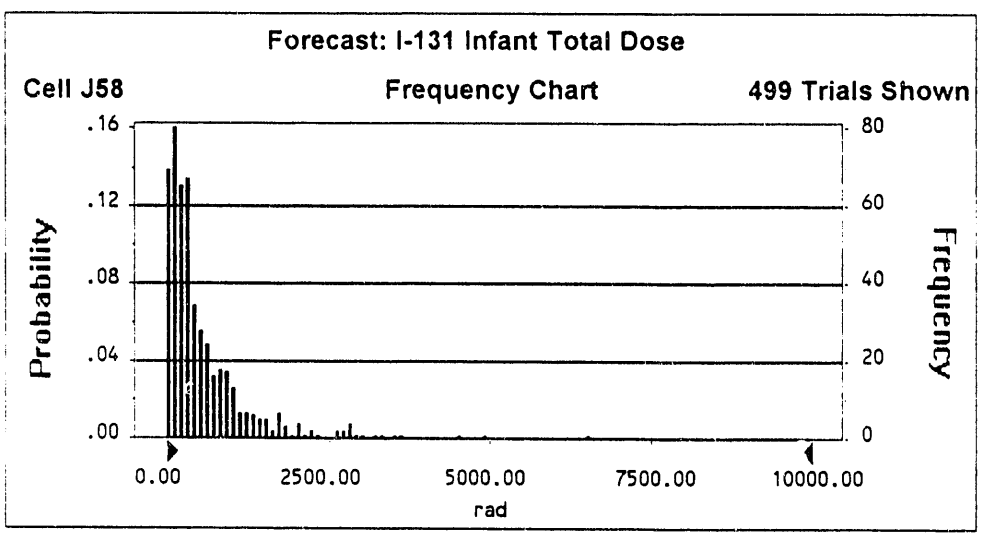
Percentile	I-131 Infant Regime 1 Milk Ingestion
0%	7.86
5%	30.54
25%	112.58
50%	279.46
75%	622.35
95%	1841.59
100%	11712.56

End of Forecast

Forecast: I-131 Infant Total Dose **Cell: J58**

Summary:
Display Range is from 0.00 to 10000.00 rad
Entire Range is from 17.48 to 11980.43 rad
After 500 Trials, the Std. Error of the Mean is 39.47

Statistics:	Display Range	Entire Range
Trials	499	500
Mean	595.02	617.79
Median	359.26	(unavailable)
Mode	83.33	(unavailable)
Standard Deviation	721.71	882.65
Variance	520861.90	779073.24
Skewness	3.20	(unavailable)
Kurtosis	18.07	(unavailable)
Coeff. of Variability	1.21	1.43
Range Minimum	0.00	17.48
Range Maximum	10000.00	11980.43
Range Width	10000.00	11962.95
Mean Std. Error	32.31	39.47



Forecast: I-131 Infant Total Dose (cont'd) **Cell: J58**

Percentiles for Entire Range (rad):

Percentile	I-131 Infant Total Dose
0%	17.48
5%	62.79
25%	169.01
50%	359.75
75%	741.90
95%	2011.30
100%	11980.43

End of Forecast

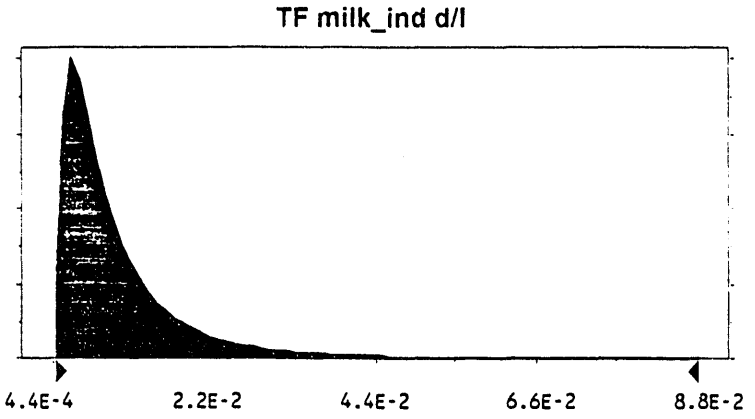
Assumptions

Assumption: TF milk_ind d/l Cell: A10

Lognormal distribution with parameters:

Mean	9.2E-03
Standard Dev.	1.0E-02

Selected range is from 8.0E-4 to 9.3E-2
Mean value in simulation was 9.2E-3



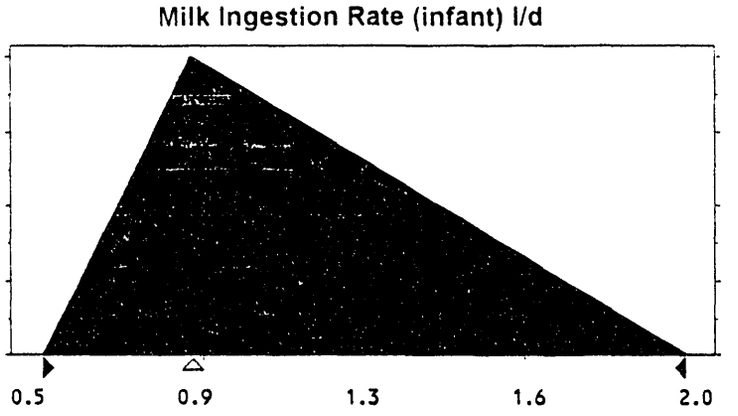
Assumption: Milk Ingestion Rate (infant) l/d Cell: A11

Triangular distribution with parameters:

Minimum	0.5
Likeliest	0.8
Maximum	2.0

Selected range is from 0.5 to 2.0
Mean value in simulation was 1.1

Assumption: Milk Ingestion Rate (infant) l/d (cont'd) **Cell: A11**

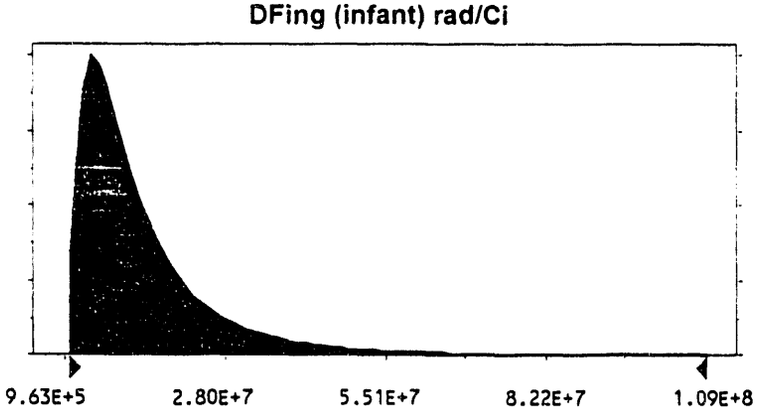


Assumption: DFing (infant) rad/Ci **Cell: A12**

Lognormal distribution with parameters:

Mean	1.40E+07
Standard Dev.	1.30E+07

Selected range is from 1.60E+6 to 1.20E+8
Mean value in simulation was 1.39E+7

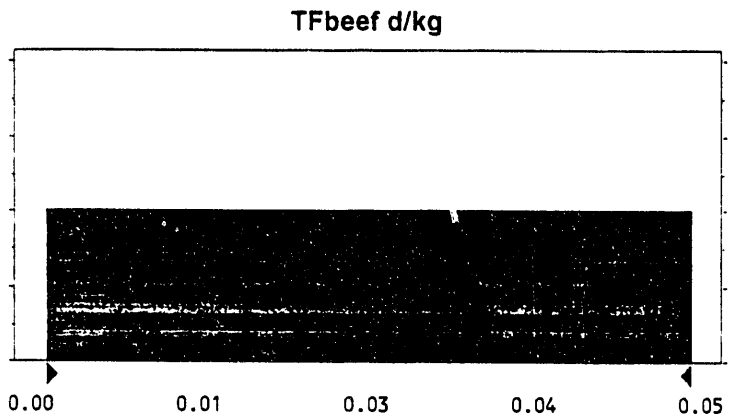


Assumption: TFbeef d/kg **Cell: A16**

Uniform distribution with parameters:

Minimum	0.00
Maximum	0.05

Selected range is from 0.00 to 0.05
Mean value in simulation was 0.03



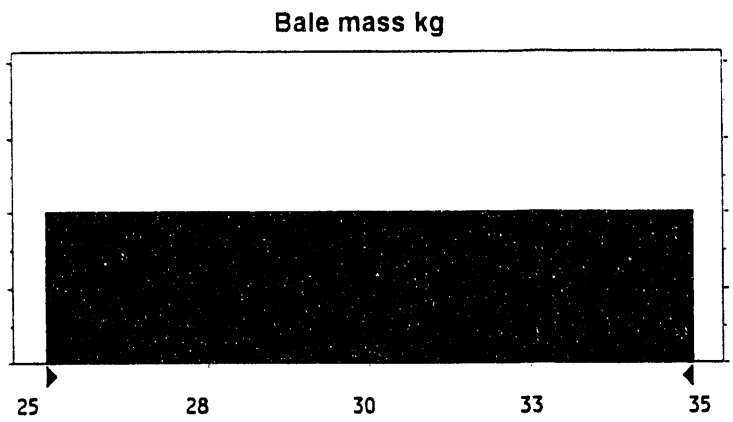
Assumption: Bale mass kg **Cell: A18**

Uniform distribution with parameters:

Minimum	25
Maximum	35

Selected range is from 25 to 35
Mean value in simulation was 30

Assumption: Bale mass kg (cont'd) **Cell: A18**

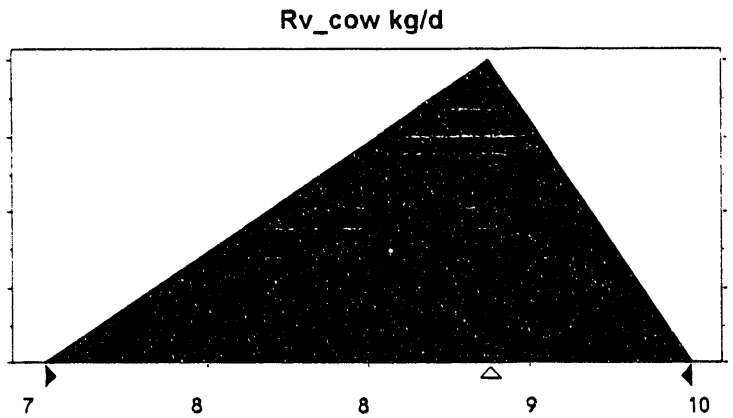


Assumption: Rv_cow kg/d **Cell: A19**

Triangular distribution with parameters:

Minimum	7
Likeliest	9
Maximum	10

Selected range is from 7 to 10
Mean value in simulation was 9

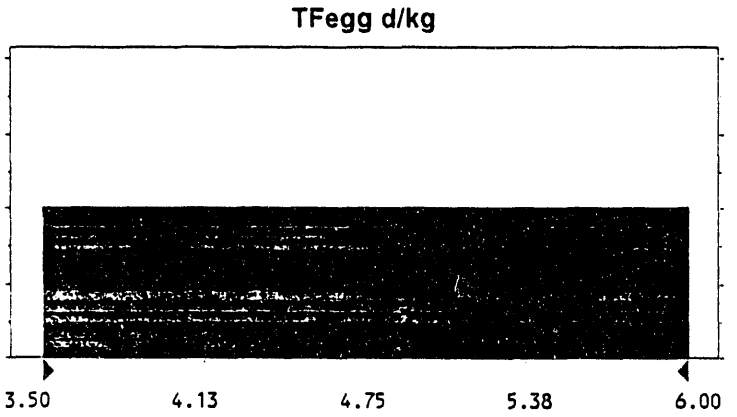


Assumption: TFegg d/kg **Cell: A21**

Uniform distribution with parameters:

Minimum	3.50
Maximum	6.00

Selected range is from 3.50 to 6.00
Mean value in simulation was 4.75



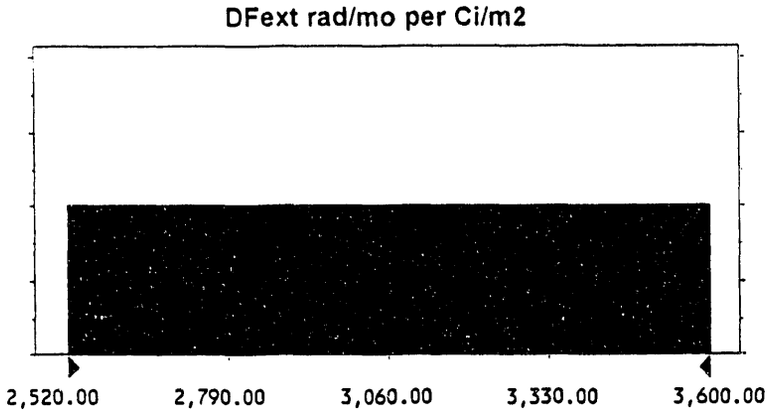
Assumption: DFext rad/mo per Ci/m2 **Cell: A26**

Uniform distribution with parameters:

Minimum	2,520.00
Maximum	3,600.00

Selected range is from 2,520.00 to 3,600.00
Mean value in simulation was 3,059.99

Assumption: DFext rad/mo per Ci/m2 (cont'd) **Cell: A26**

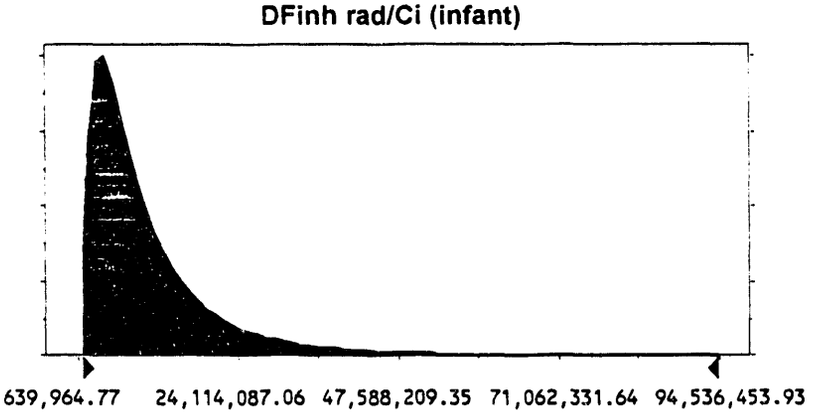


Assumption: DFinh rad/Ci (infant) **Cell: A27**

Lognormal distribution with parameters:

Mean	11,000,000.00
Standard Dev.	11,000,000.00

Selected range is from 1,265,941.36 to 94,223,465.63
Mean value in simulation was 10,936,630.74

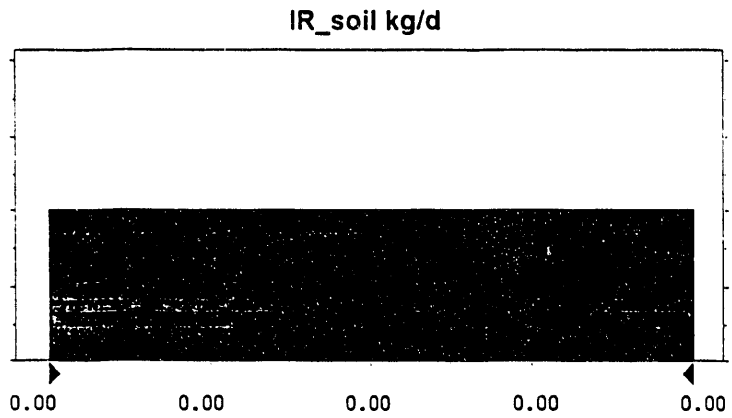


Assumption: IR_soil kg/d **Cell: A28**

Uniform distribution with parameters:

Minimum	0.00
Maximum	0.00

Selected range is from 0.00 to 0.00
Mean value in simulation was 0.00



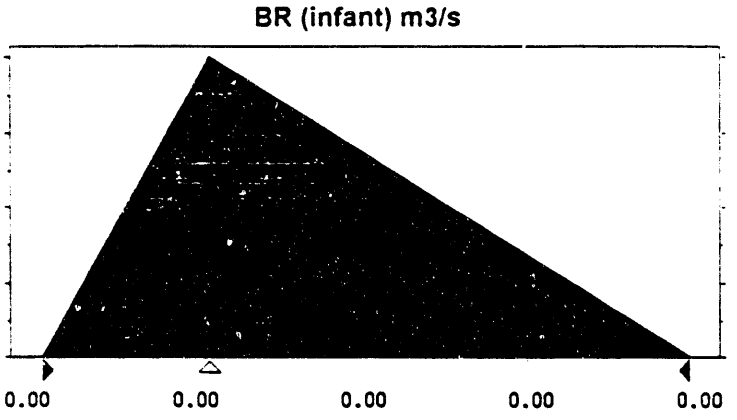
Assumption: BR (infant) m3/s **Cell: A29**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.00
Maximum	0.00

Selected range is from 0.00 to 0.00
Mean value in simulation was 0.00

Assumption: BR (infant) m3/s (cont'd) **Cell: A29**

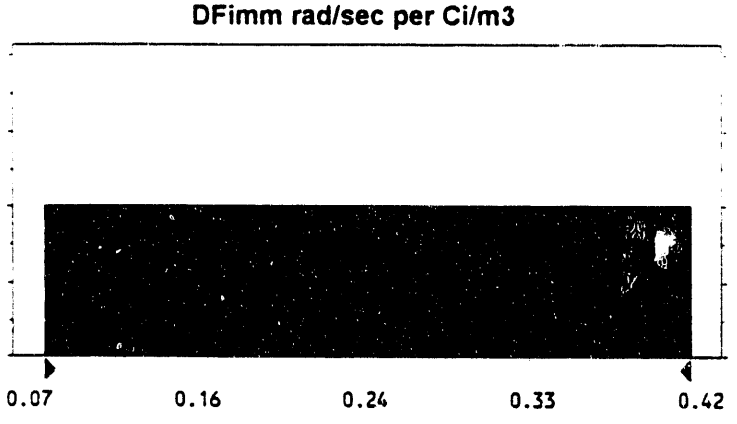


Assumption: DFimm rad/sec per Ci/m3 **Cell: A32**

Uniform distribution with parameters:

Minimum	0.07
Maximum	0.42

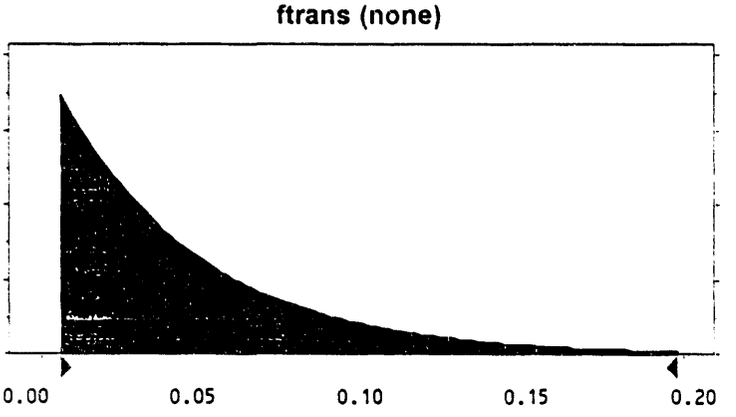
Selected range is from 0.07 to 0.42
Mean value in simulation was 0.24



Assumption: ftrans (none) **Cell: A33**

Exponential distribution with parameters:
Rate 23.00

Selected range is from 0.01 to 0.20
Mean value in simulation was 0.05



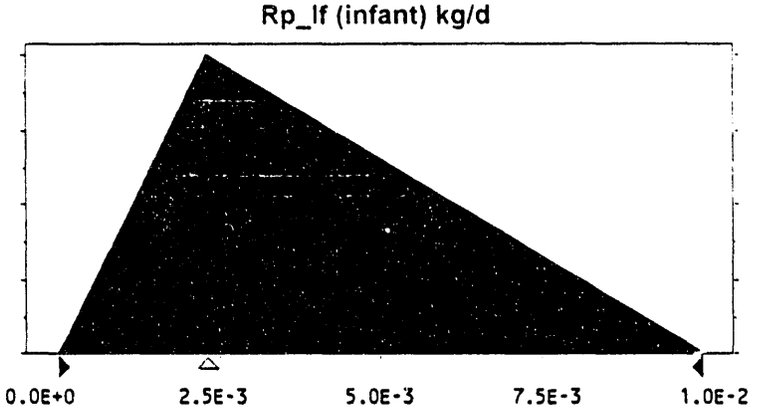
Assumption: Rp_If (infant) kg/d **Cell: A30**

Triangular distribution with parameters:

Minimum	0.0E+00
Likeliest	2.3E-03
Maximum	1.0E-02

Selected range is from 0.0E+0 to 1.0E-2
Mean value in simulation was 4.1E-3

Assumption: Rp_lf (infant) kg/d (cont'd) **Cell: A30**

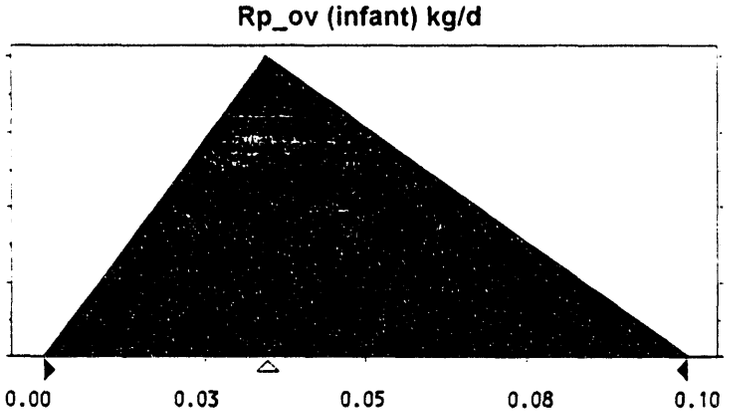


Assumption: Rp_ov (infant) kg/d **Cell: A31**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.03
Maximum	0.10

Selected range is from 0.00 to 0.10
Mean value in simulation was 0.04

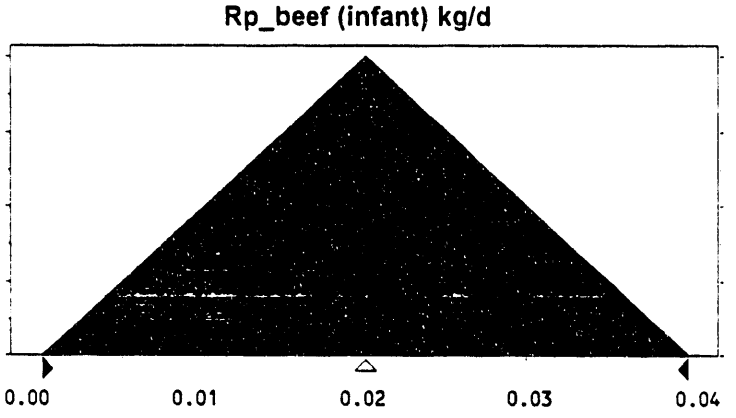


Assumption: Rp_beef (infant) kg/d **Cell: A34**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.02
Maximum	0.04

Selected range is from 0.00 to 0.04
Mean value in simulation was 0.02



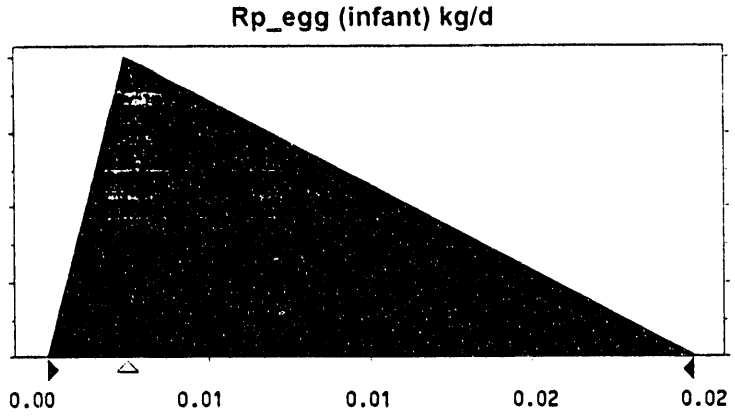
Assumption: Rp_egg (infant) kg/d **Cell: A35**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.01
Maximum	0.02

Selected range is from 0.00 to 0.02
Mean value in simulation was 0.01

Assumption: Rp_egg (infant) kg/d (cont'd) **Cell: A35**

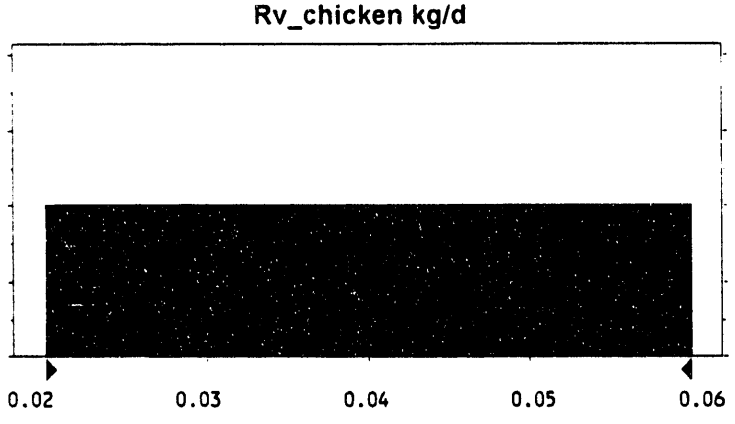


Assumption: Rv_chicken kg/d **Cell: A36**

Uniform distribution with parameters:

Minimum	0.02
Maximum	0.06

Selected range is from 0.02 to 0.06
Mean value in simulation was 0.04

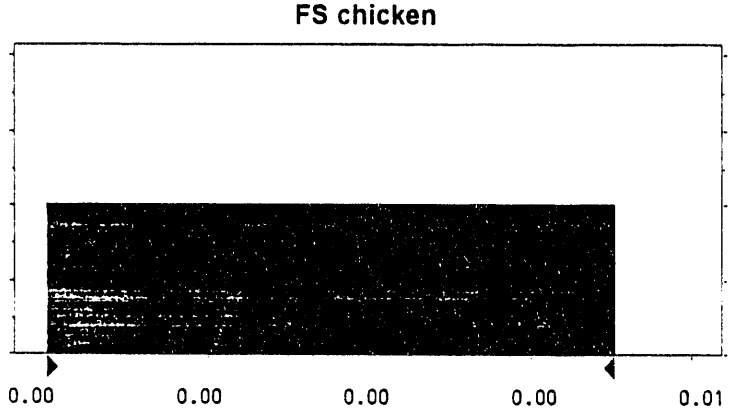


Assumption: FS chicken **Cell: A37**

Uniform distribution with parameters:

Minimum	0.00
Maximum	0.01

Selected range is from 0.00 to 0.00
Mean value in simulation was 0.00



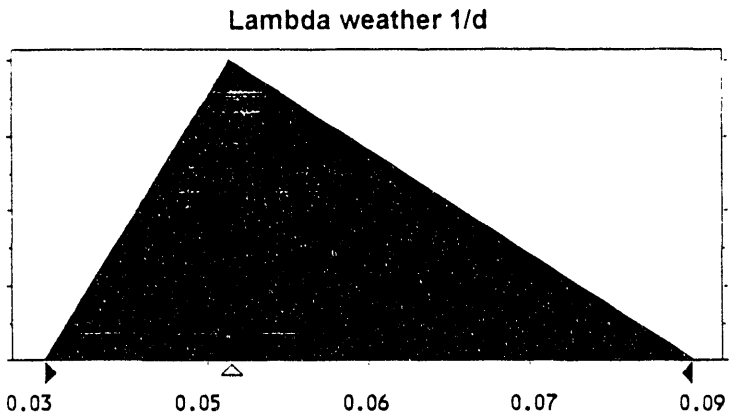
Assumption: Lambda weather 1/d **Cell: A24**

Triangular distribution with parameters:

Minimum	0.03
Likeliest	0.05
Maximum	0.09

Selected range is from 0.03 to 0.09
Mean value in simulation was 0.06

Assumption: Lambda weather 1/d (cont'd) **Cell: A24**



End of Assumptions

APPENDIX B

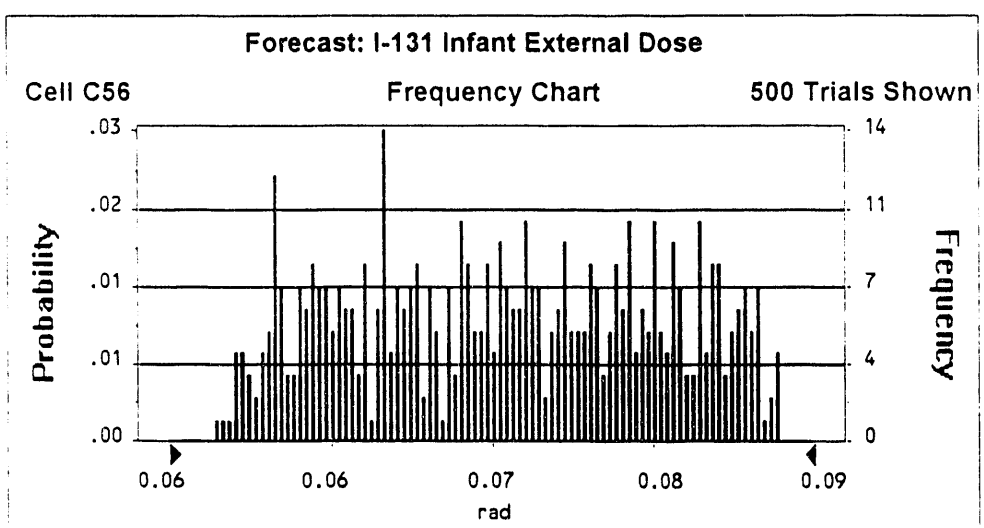
REPORT OF STOCHASTIC SIMULATION OF INDIVIDUAL INFANT DOSE FROM IODINE-131 RELEASES IN 1945, DOSE FACTOR AND FEED-TO-MILK TRANSFER FACTOR HELD CONSTANT

Crystal Ball Report
Simulation started on 12/3/92 at 10:58:05
Simulation stopped on 12/3/92 at 11:04:18

Forecast: I-131 Infant External Dose **Cell: C56**

Summary:
Display Range is from 0.06 to 0.09 rad
Entire Range is from 0.06 to 0.08 rad
After 500 Trials, the Std. Error of the Mean is 0.00

Statistics:	Display Range	Entire Range
Trials	500	500
Mean	0.07	0.07
Median	0.07	0.07
Mode	0.06	0.06
Standard Deviation	0.01	0.01
Variance	0.00	0.00
Skewness	-0.01	-0.01
Kurtosis	1.83	1.83
Coeff. of Variability	0.10	0.10
Range Minimum	0.06	0.06
Range Maximum	0.09	0.08
Range Width	0.03	0.03
Mean Std. Error	0.00	0.00



Forecast: I-131 Infant External Dose (cont'd) **Cell: C56**

Percentiles for Entire Range (rad):

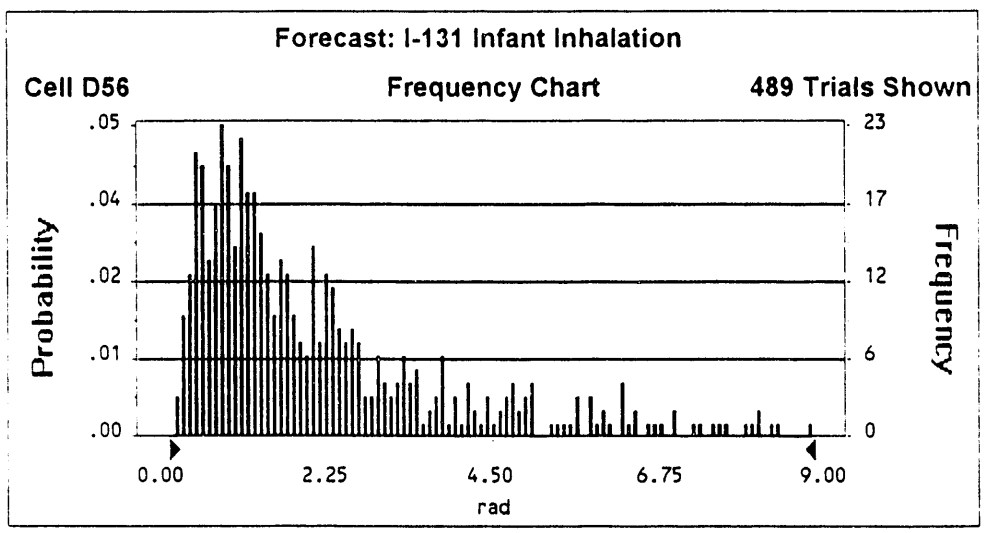
Percentile	I-131 Infant External Dose
0%	0.06
5%	0.06
25%	0.06
50%	0.07
75%	0.08
95%	0.08
100%	0.08

End of Forecast

Forecast: I-131 Infant Inhalation **Cell: D56**

Summary:
Display Range is from 0.00 to 9.00 rad
Entire Range is from 0.10 to 22.92 rad
After 500 Trials, the Std. Error of the Mean is 0.11

Statistics:	Display Range	Entire Range
Trials	489	500
Mean	2.11	2.36
Median	1.51	(unavailable)
Mode	0.77	(unavailable)
Standard Deviation	1.80	2.54
Variance	3.25	6.47
Skewness	1.51	(unavailable)
Kurtosis	4.91	(unavailable)
Coeff. of Variability	0.85	1.08
Range Minimum	0.00	0.10
Range Maximum	9.00	22.92
Range Width	9.00	22.82
Mean Std. Error	0.08	0.11



Forecast: I-131 Infant Inhalation (cont'd) **Cell: D56**

Percentiles for Entire Range (rad):

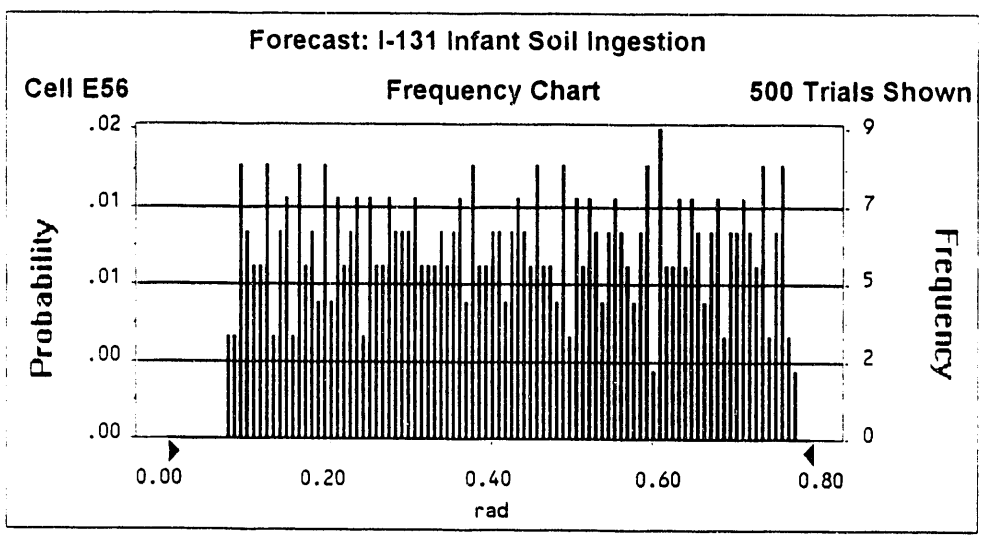
Percentile	I-131 Infant Inhalation
0%	0.10
5%	0.36
25%	0.83
50%	1.57
75%	2.89
95%	6.87
100%	22.92

End of Forecast

Forecast: I-131 Infant Soil Ingestion **Cell: E56**

Summary:
Display Range is from 0.00 to 0.80 rad
Entire Range is from 0.08 to 0.78 rad
After 500 Trials, the Std. Error of the Mean is 0.01

Statistics:	Display Range	Entire Range
Trials	500	500
Mean	0.43	0.43
Median	0.43	0.43
Mode	0.46	0.46
Standard Deviation	0.20	0.20
Variance	0.04	0.04
Skewness	0.00	0.00
Kurtosis	1.79	1.79
Coeff. of Variability	0.47	0.47
Range Minimum	0.00	0.08
Range Maximum	0.80	0.78
Range Width	0.80	0.70
Mean Std. Error	0.01	0.01



Forecast: I-131 Infant Soil Ingestion (cont'd) **Cell: E56**

Percentiles for Entire Range (rad):

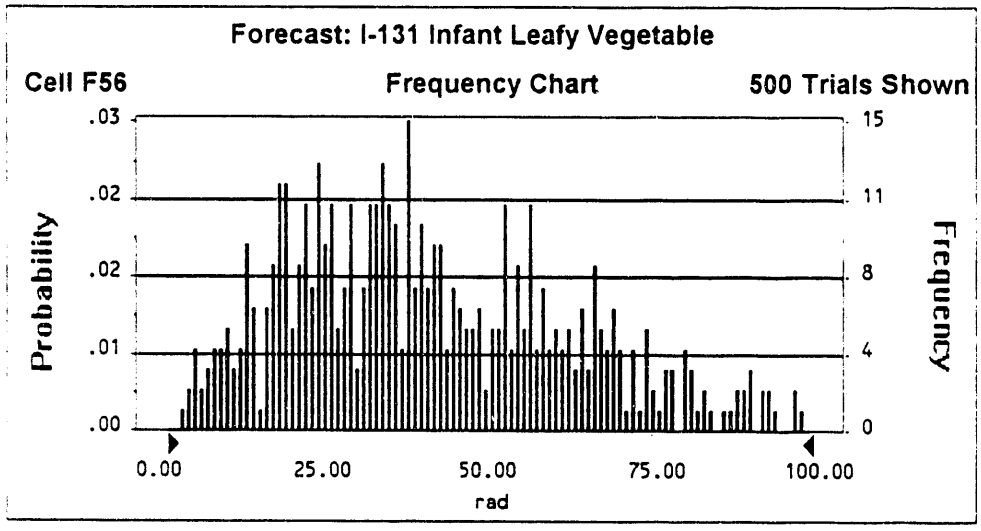
Percentile	I-131 Infant Soil Ingestion
0%	0.08
5%	0.11
25%	0.25
50%	0.43
75%	0.60
95%	0.74
100%	0.78

End of Forecast

Forecast: I-131 Infant Leafy Vegetable **Cell: F56**

Summary:
Display Range is from 0.00 to 100.00 rad
Entire Range is from 2.62 to 98.29 rad
After 500 Trials, the Std. Error of the Mean is 0.96

Statistics:	Display Range	Entire Range
Trials	500	500
Mean	40.74	40.74
Median	37.42	37.42
Mode	32.83	32.83
Standard Deviation	21.57	21.57
Variance	465.39	465.39
Skewness	0.49	0.49
Kurtosis	2.52	2.52
Coeff. of Variability	0.53	0.53
Range Minimum	0.00	2.62
Range Maximum	100.00	98.29
Range Width	100.00	95.66
Mean Std. Error	0.96	0.96



Forecast: I-131 Infant Leafy Vegetable (cont'd) **Cell: F56**

Percentiles for Entire Range (rad):

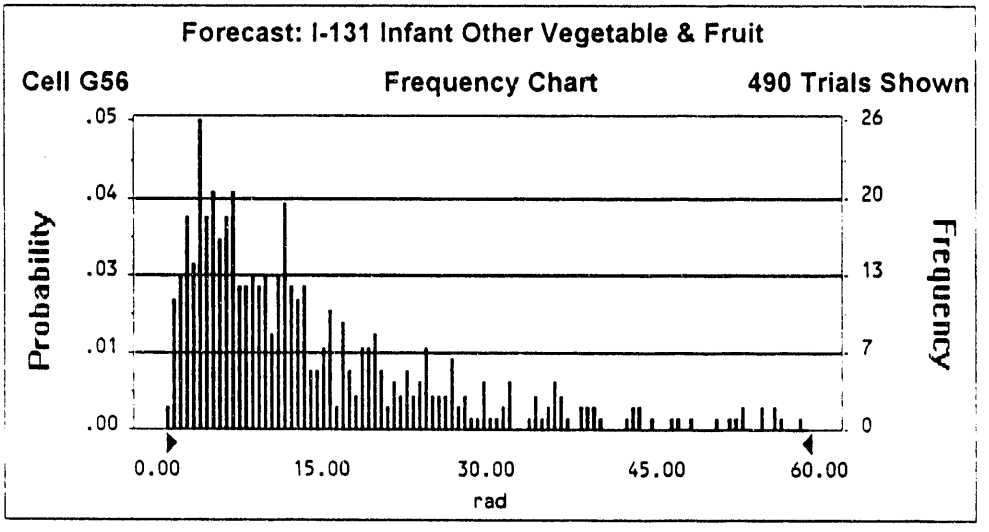
Percentile	I-131 Infant Leafy Vegetable
0%	2.62
5%	9.96
25%	23.48
50%	37.46
75%	56.09
95%	80.64
100%	98.29

End of Forecast

Forecast: I-131 Infant Other Vegetable & Fruit **Cell: G56**

Summary:
Display Range is from 0.00 to 60.00 rad
Entire Range is from 0.28 to 93.45 rad
After 500 Trials, the Std. Error of the Mean is 0.68

Statistics:	Display Range	Entire Range
Trials	490	500
Mean	13.61	14.97
Median	10.13	(unavailable)
Mode	3.10	(unavailable)
Standard Deviation	12.03	15.30
Variance	144.82	234.20
Skewness	1.53	(unavailable)
Kurtosis	5.16	(unavailable)
Coeff. of Variability	0.88	1.02
Range Minimum	0.00	0.28
Range Maximum	60.00	93.45
Range Width	60.00	93.17
Mean Std. Error	0.54	0.68



Forecast: I-131 Infant Other Vegetable & Fruit (cont'd) **Cell: G56**

Percentiles for Entire Range (rad):

Percentile	I-131 Infant Other Vegetable & Fruit
0%	0.28
5%	1.80
25%	4.97
50%	10.34
75%	19.28
95%	44.38
100%	93.45

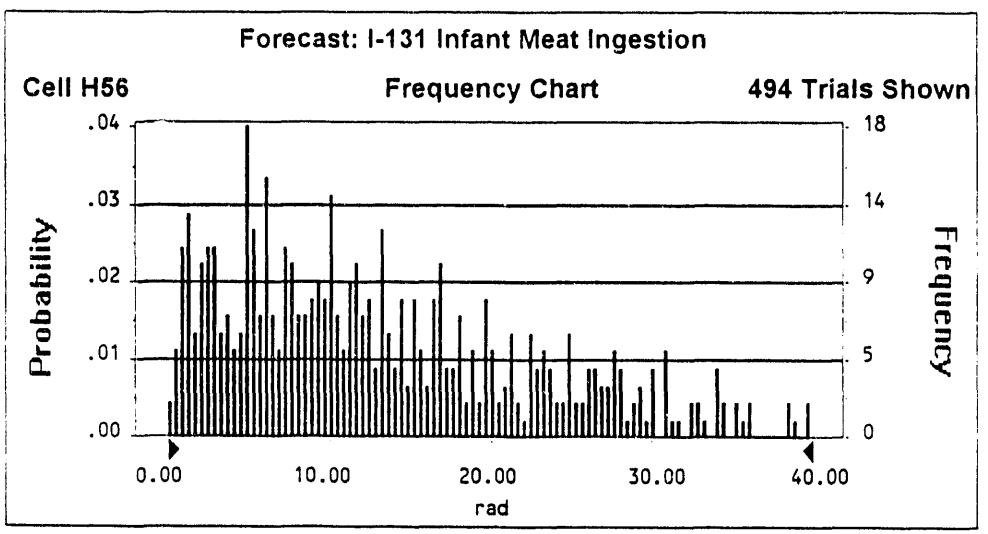
End of Forecast

Forecast: I-131 Infant Meat Ingestion **Cell: H56**

Summary:

Display Range is from 0.00 to 40.00 rad
Entire Range is from 0.24 to 46.32 rad
After 500 Trials, the Std. Error of the Mean is 0.44

Statistics:	Display Range	Entire Range
Trials	494	500
Mean	13.26	13.62
Median	11.37	(unavailable)
Mode	2.60	(unavailable)
Standard Deviation	9.32	9.82
Variance	86.84	96.46
Skewness	0.72	(unavailable)
Kurtosis	2.70	(unavailable)
Coeff. of Variability	0.70	0.72
Range Minimum	0.00	0.24
Range Maximum	40.00	46.32
Range Width	40.00	46.08
Mean Std. Error	0.42	0.44



Forecast: I-131 Infant Meat Ingestion (cont'd) **Cell: H56**

Percentiles for Entire Range (rad):

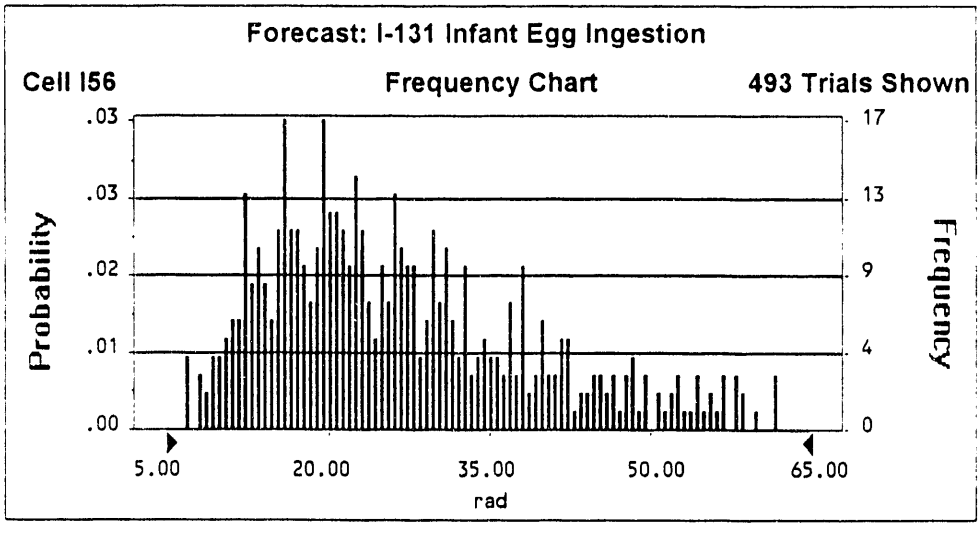
Percentile	I-131 Infant Meat Ingestion
0%	0.24
5%	1.47
25%	5.70
50%	11.46
75%	19.75
95%	32.81
100%	46.32

End of Forecast

Forecast: I-131 Infant Egg Ingestion **Cell: I56**

Summary:
Display Range is from 5.00 to 65.00 rad
Entire Range is from 6.87 to 77.03 rad
After 500 Trials, the Std. Error of the Mean is 0.60

Statistics:	Display Range	Entire Range
Trials	493	500
Mean	26.77	27.42
Median	24.00	(unavailable)
Mode	22.70	(unavailable)
Standard Deviation	12.24	13.33
Variance	149.82	177.76
Skewness	0.79	(unavailable)
Kurtosis	2.99	(unavailable)
Coeff. of Variability	0.46	0.49
Range Minimum	5.00	6.87
Range Maximum	65.00	77.03
Range Width	60.00	70.15
Mean Std. Error	0.55	0.60



Forecast: I-131 Infant Egg Ingestion (cont'd) **Cell: I56**

Percentiles for Entire Range (rad):

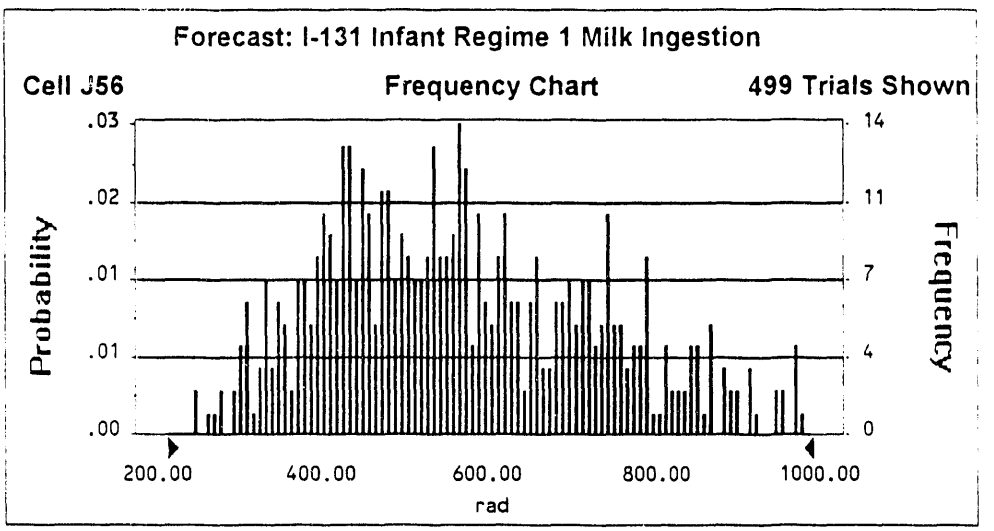
Percentile	I-131 Infant Egg Ingestion
0%	6.87
5%	11.32
25%	17.28
50%	24.41
75%	34.58
95%	54.23
100%	77.03

End of Forecast

Forecast: I-131 Infant Regime 1 Milk Ingestion **Cell: J56**

Summary:
Display Range is from 200.00 to 1000.00 rad
Entire Range is from 233.77 to 1001.78 rad
After 500 Trials, the Std. Error of the Mean is 7.48

Statistics:	Display Range	Entire Range
Trials	499	500
Mean	565.07	565.95
Median	546.67	(unavailable)
Mode	572.00	(unavailable)
Standard Deviation	166.29	167.27
Variance	27653.99	27979.99
Skewness	0.42	(unavailable)
Kurtosis	2.46	(unavailable)
Coeff. of Variability	0.29	0.30
Range Minimum	200.00	233.77
Range Maximum	1000.00	1001.78
Range Width	800.00	768.01
Mean Std. Error	7.44	7.48



Forecast: I-131 Infant Regime 1 Milk Ingestion (cont'd) **Cell: J56**

Percentiles for Entire Range (rad):

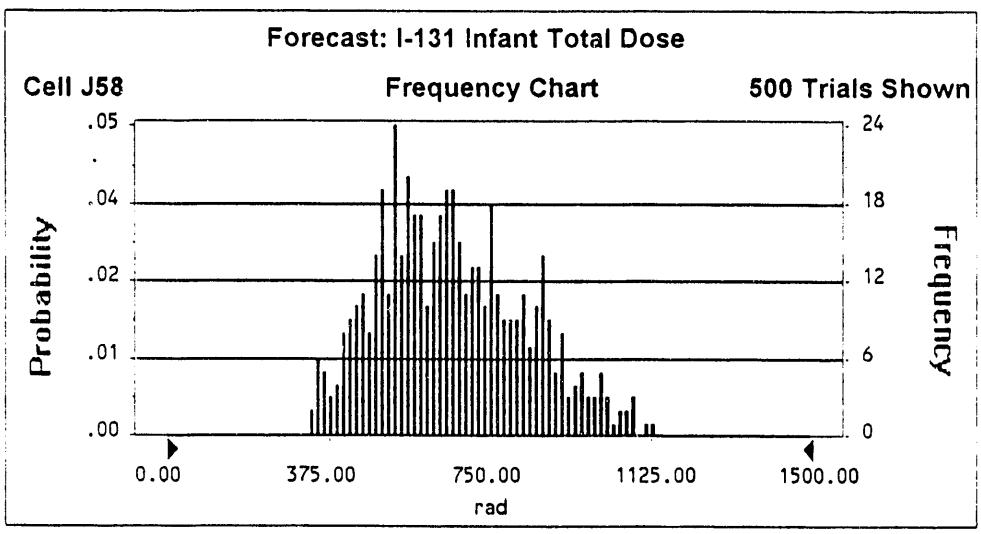
Percentile	I-131 Infant Regime 1 Milk Ingestion
0%	233.77
5%	324.65
25%	432.17
50%	549.17
75%	689.45
95%	872.50
100%	1001.78

End of Forecast

Forecast: I-131 Infant Total Dose **Cell: J58**

Summary:
Display Range is from 0.00 to 1500.00 rad
Entire Range is from 339.23 to 1128.29 rad
After 500 Trials, the Std. Error of the Mean is 7.63

Statistics:	Display Range	Entire Range
Trials	500	500
Mean	665.56	665.56
Median	652.14	652.14
Mode	507.50	507.50
Standard Deviation	170.55	170.55
Variance	29086.82	29086.82
Skewness	0.37	0.37
Kurtosis	2.49	2.49
Coeff. of Variability	0.26	0.26
Range Minimum	0.00	339.23
Range Maximum	1500.00	1128.29
Range Width	1500.00	789.06
Mean Std. Error	7.63	7.63



Forecast: I-131 Infant Total Dose (cont'd) **Cell: J58**

Percentiles for Entire Range (rad):

Percentile	I-131 Infant Total Dose
0%	339.23
5%	416.38
25%	534.39
50%	651.35
75%	783.73
95%	973.11
100%	1128.29

End of Forecast

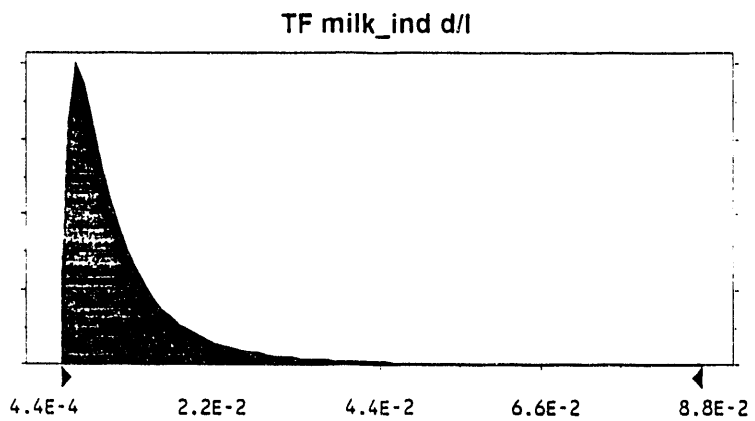
Assumptions

Assumption: TF milk_ind d/l Cell: A10

Lognormal distribution with parameters:

Mean	9.2E-03
Standard Dev.	1.0E-02

Selected range is from 8.0E-4 to 9.3E-2
** Excluded Assumption ** value used was 9.2E-3



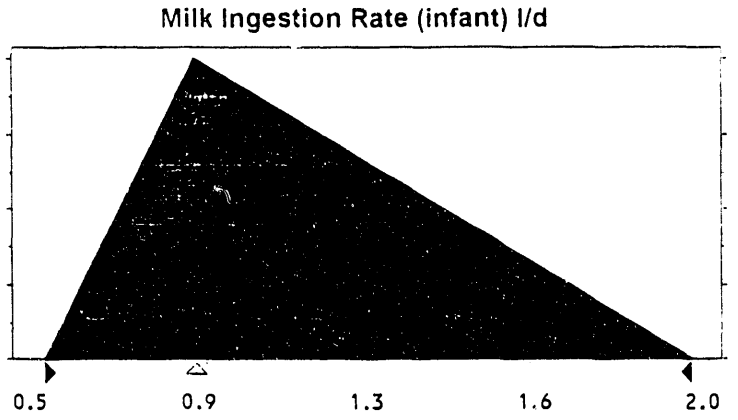
Assumption: Milk Ingestion Rate (infant) l/d Cell: A11

Triangular distribution with parameters:

Minimum	0.5
Likeliest	0.8
Maximum	2.0

Selected range is from 0.5 to 2.0
Mean value in simulation was 1.1

Assumption: Milk Ingestion Rate (infant) l/d (cont'd) **Cell: A11**

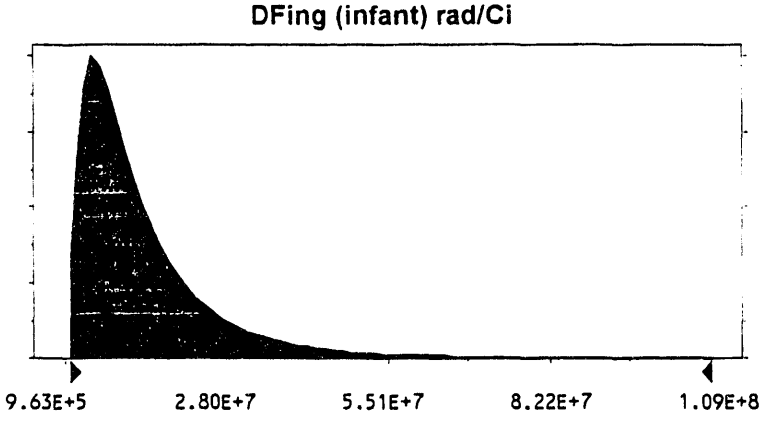


Assumption: DFing (infant) rad/Ci **Cell: A12**

Lognormal distribution with parameters:

Mean	1.40E+07
Standard Dev.	1.30E+07

Selected range is from 1.60E+6 to 1.20E+8
** Excluded Assumption ** value used was 1.50E+7

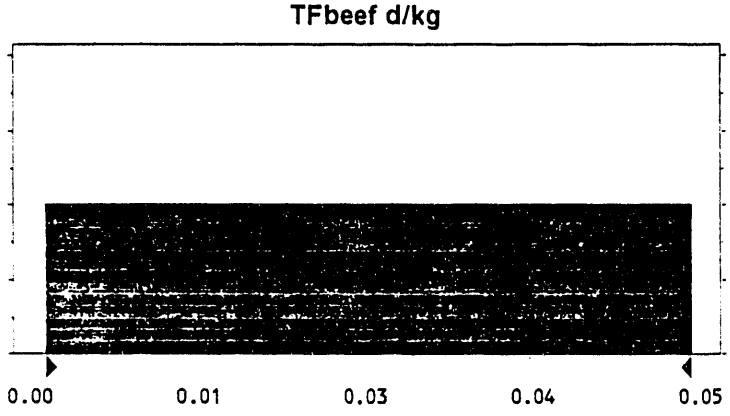


Assumption: TFbeef d/kg **Cell: A16**

Uniform distribution with parameters:

Minimum	0.00
Maximum	0.05

Selected range is from 0.00 to 0.05
Mean value in simulation was 0.03



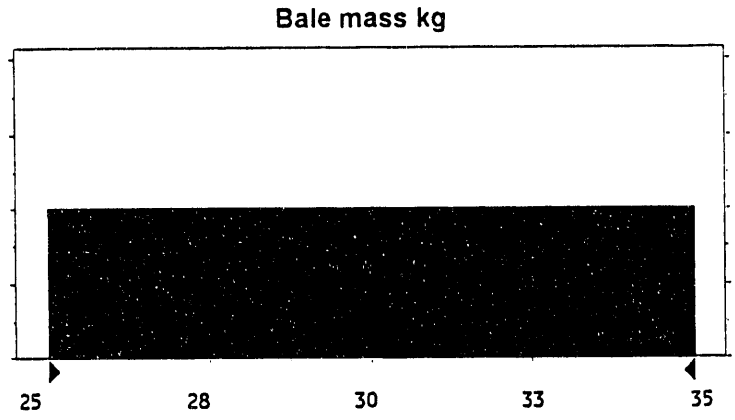
Assumption: Bale mass kg **Cell: A18**

Uniform distribution with parameters:

Minimum	25
Maximum	35

Selected range is from 25 to 35
Mean value in simulation was 30

Assumption: Bale mass kg (cont'd) **Cell: A18**

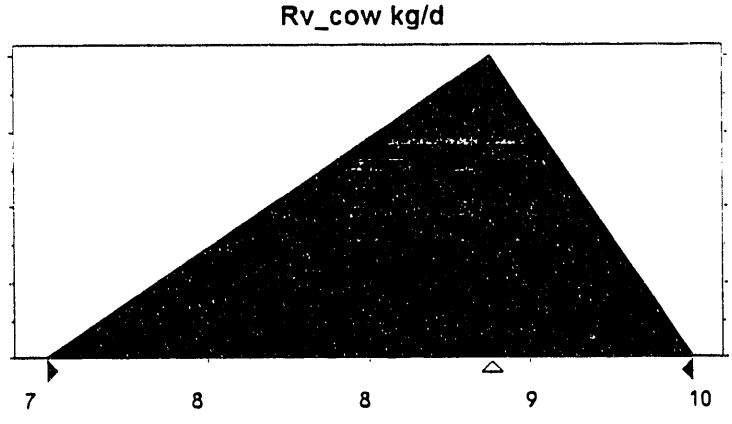


Assumption: Rv_cow kg/d **Cell: A19**

Triangular distribution with parameters:

Minimum	7
Likeliest	9
Maximum	10

Selected range is from 7 to 10
Mean value in simulation was 9

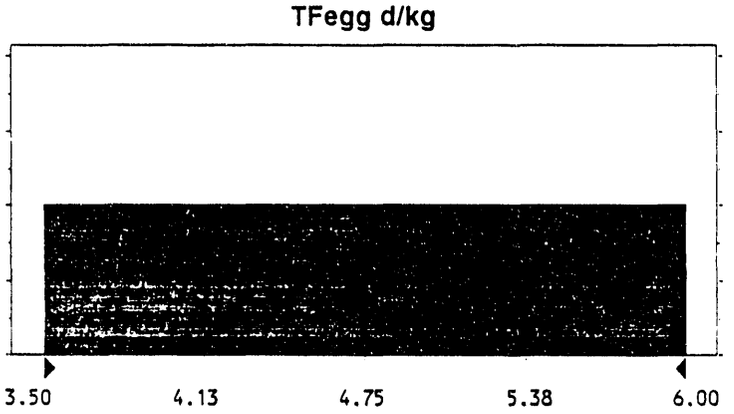


Assumption: TFegg d/kg **Cell: A21**

Uniform distribution with parameters:

Minimum	3.50
Maximum	6.00

Selected range is from 3.50 to 6.00
Mean value in simulation was 4.75



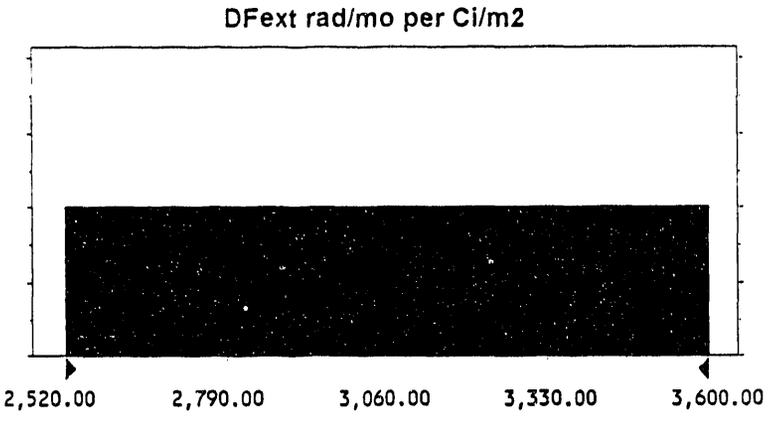
Assumption: DFext rad/mo per Ci/m2 **Cell: A26**

Uniform distribution with parameters:

Minimum	2,520.00
Maximum	3,600.00

Selected range is from 2,520.00 to 3,600.00
Mean value in simulation was 3,060.01

Assumption: DFext rad/mo per Ci/m2 (cont'd) **Cell: A26**

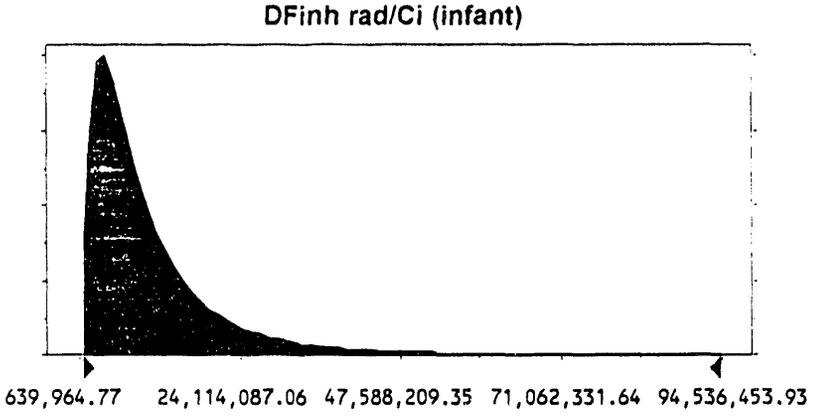


Assumption: DFinh rad/Ci (infant) **Cell: A27**

Lognormal distribution with parameters:

Mean	11,000,000.00
Standard Dev.	11,000,000.00

Selected range is from 1,265,941.36 to 94,223,465.63
Mean value in simulation was 10,996,124.32

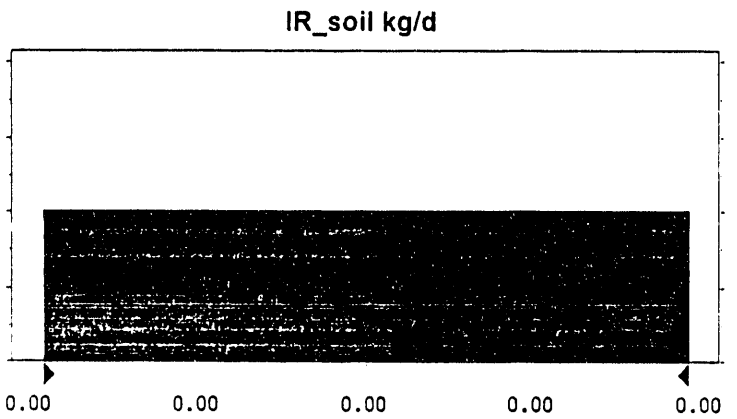


Assumption: IR_soil kg/d **Cell: A28**

Uniform distribution with parameters:

Minimum	0.00
Maximum	0.00

Selected range is from 0.00 to 0.00
Mean value in simulation was 0.00



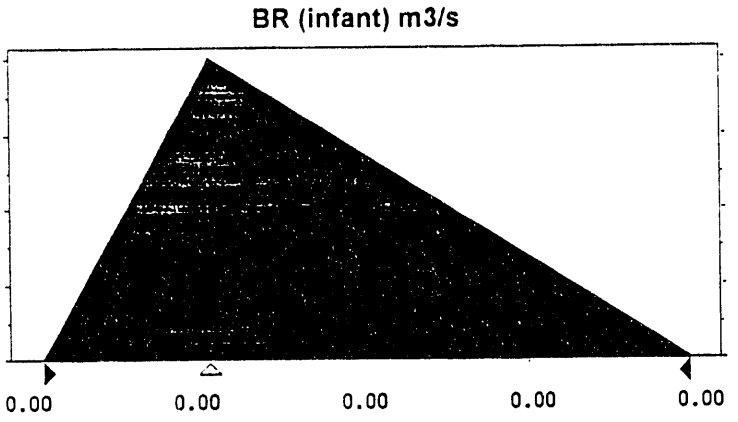
Assumption: BR (infant) m3/s **Cell: A29**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.00
Maximum	0.00

Selected range is from 0.00 to 0.00
Mean value in simulation was 0.00

Assumption: BR (infant) m3/s (cont'd) **Cell: A29**

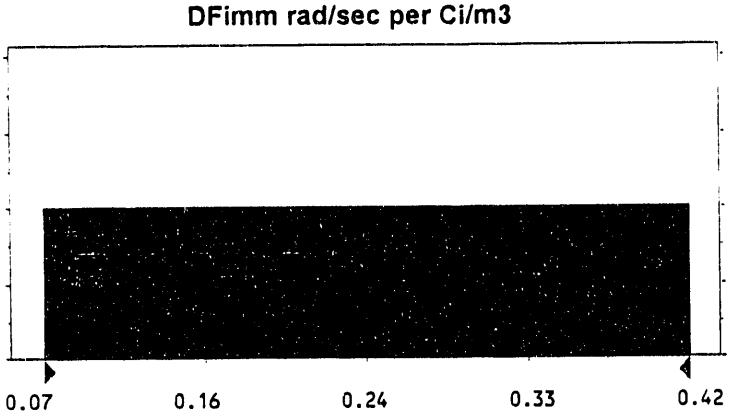


Assumption: DFimm rad/sec per Ci/m3 **Cell: A32**

Uniform distribution with parameters:

Minimum	0.07
Maximum	0.42

Selected range is from 0.07 to 0.42
Mean value in simulation was 0.25

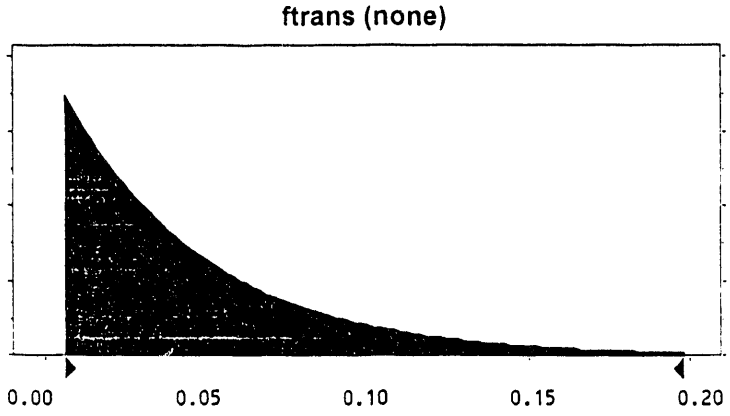


Assumption: ftrans (none) **Cell: A33**

Exponential distribution with parameters:

Rate	23.00

Selected range is from 0.01 to 0.20
Mean value in simulation was 0.05



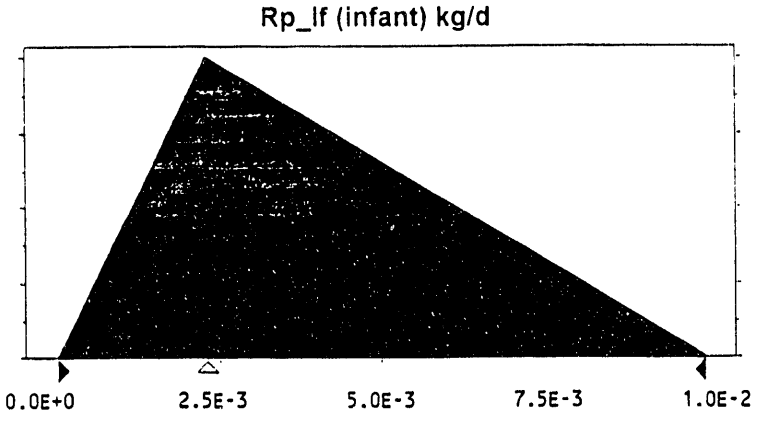
Assumption: Rp_If (infant) kg/d **Cell: A30**

Triangular distribution with parameters:

Minimum	0.0E+00
Likeliest	2.3E-03
Maximum	1.0E-02

Selected range is from 0.0E+0 to 1.0E-2
Mean value in simulation was 4.1E-3

Assumption: Rp_lf (infant) kg/d (cont'd) **Cell: A30**

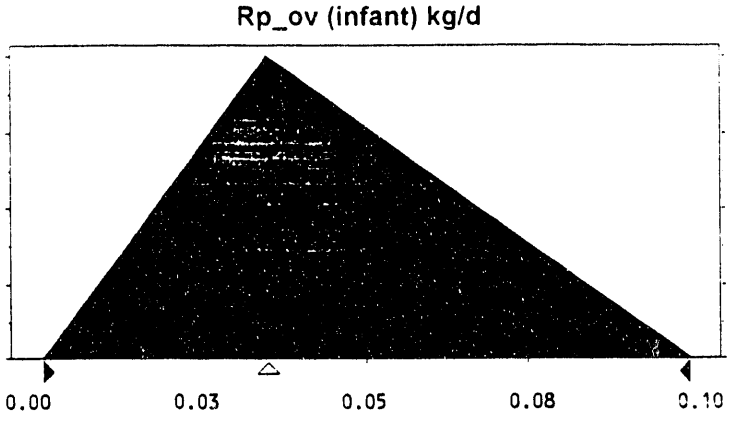


Assumption: Rp_ov (infant) kg/d **Cell: A31**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.03
Maximum	0.10

Selected range is from 0.00 to 0.10
Mean value in simulation was 0.04

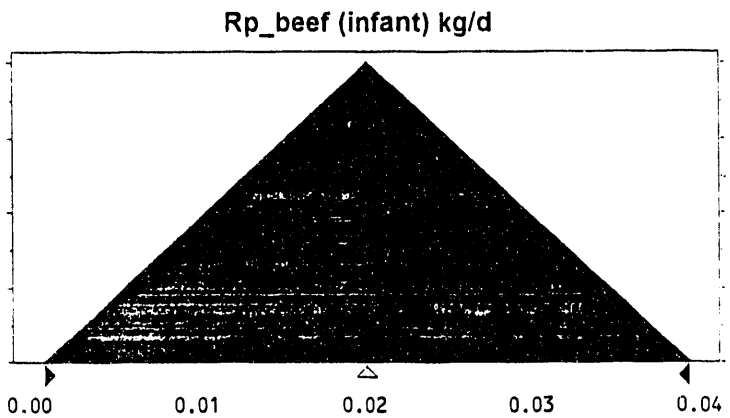


Assumption: Rp_beef (infant) kg/d **Cell: A34**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.02
Maximum	0.04

Selected range is from 0.00 to 0.04
Mean value in simulation was 0.02



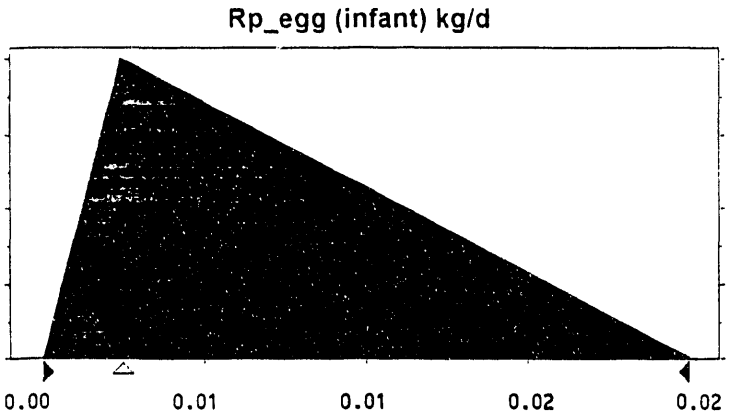
Assumption: Rp_egg (infant) kg/d **Cell: A35**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.01
Maximum	0.02

Selected range is from 0.00 to 0.02
Mean value in simulation was 0.01

Assumption: Rp_egg (infant) kg/d (cont'd) **Cell: A35**

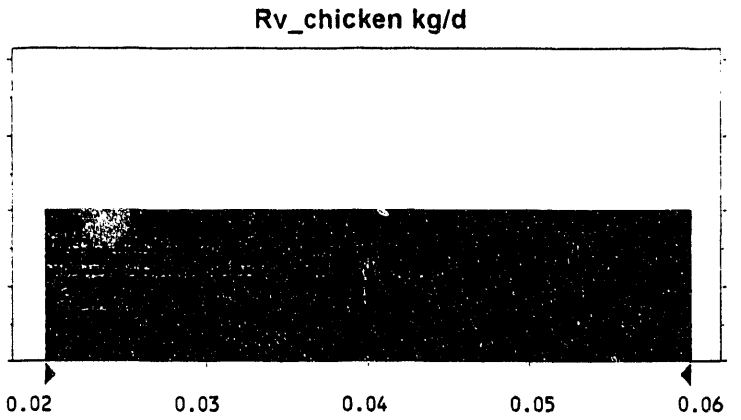


Assumption: Rv_chicken kg/d **Cell: A36**

Uniform distribution with parameters:

Minimum	0.02
Maximum	0.06

Selected range is from 0.02 to 0.06
Mean value in simulation was 0.04

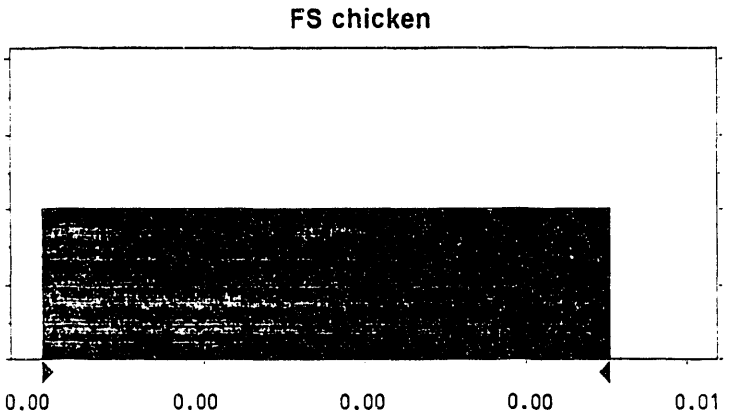


Assumption: FS chicken **Cell: A37**

Uniform distribution with parameters:

Minimum	0.00
Maximum	0.01

Selected range is from 0.00 to 0.00
Mean value in simulation was 0.00



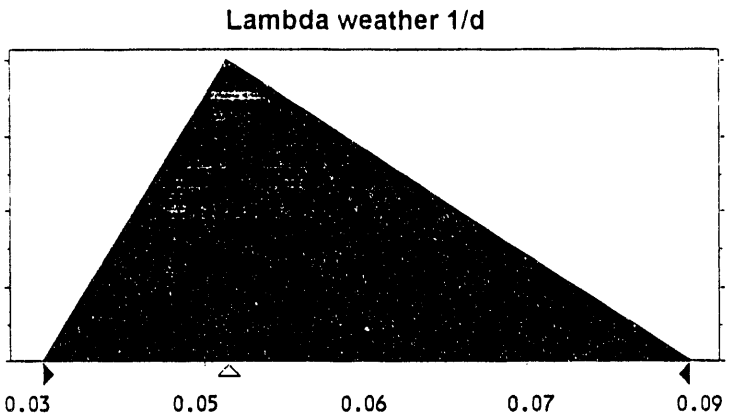
Assumption: Lambda weather 1/d **Cell: A24**

Triangular distribution with parameters:

Minimum	0.03
Likeliest	0.05
Maximum	0.09

Selected range is from 0.03 to 0.09
Mean value in simulation was 0.06

Assumption: Lambda weather 1/d (cont'd) **Cell: A24**



End of Assumptions

APPENDIX C

REPORT OF PILOT CODE ANALYSIS OF INFANT DOSE FROM IODINE-131 RELEASES IN 1945

REPORT OF PILOT CODE ANALYSIS OF INFANT DOSE FROM IODINE-131 RELEASES IN 1945

The following pages were prepared with the PILOT code. The PILOT output was manipulated into a readable form using commercial software called SAS®. Data are provided that define the distribution of calculated doses for 1945 for infants drinking milk from backyard cows fed on Feeding Regime 1. Data are provided for three locations and their surroundings: Baker City, Oregon, Eltopia, Washington, and Spokane, Washington. The node representing Baker City is node 152. That representing Eltopia is node 962. The node representing Spokane is node 1507.

Several statistics are provided for each node. Doses are presented for each month of the year 1945. The months are labeled MON. Results of the stochastic analyses are provided in terms of the minimum (MIN), fifth percentile (P5), twenty-fifth percentile (Q1), median (MEDIAN), seventy-fifth percentile (Q3), ninety-fifth percentile (P95), and maximum (MAX) value calculated in the 100 realizations. The totals at the bottom of each column are the actual calculated totals for the year, they may not be the sum of the individual monthly values.

NODE=152 (BAKER)

MON	MIN	P5	Q1	MEDIAN	Q3	P95	MAX
1	0.000000	0.000000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.000000	0.000000	0.00000	0.00000	0.00000	0.00000	0.00000
3	0.000000	0.000000	0.00000	0.00000	0.00001	0.00007	0.00014
4	0.000000	0.000001	0.00000	0.00000	0.00001	0.00002	0.00007
5	0.000415	0.001065	0.00293	0.00723	0.02022	0.08546	0.24551
6	0.000105	0.001289	0.00422	0.01245	0.03387	0.22328	0.85636
7	0.000066	0.000630	0.00193	0.00398	0.01518	0.06669	0.75894
8	0.010034	0.051747	0.16672	0.35816	0.63827	3.06945	6.16570
9	0.006474	0.030265	0.07283	0.14054	0.29034	0.73767	1.24954
10	0.000924	0.004233	0.01131	0.02333	0.05362	0.20618	0.40425
11	0.000158	0.000363	0.00082	0.00167	0.00380	0.01033	0.02501
12	0.000015	0.000041	0.00007	0.00016	0.00035	0.00076	0.00215
	0.019820	0.10982	0.30480	0.61920	1.05397	4.68724	8.69579

NODE=962 (ELTOPIA)

MON	MIN	P5	Q1	MEDIAN	Q3	P95	MAX
1	0.00025	0.00066	0.0027	0.0065	0.0156	0.036	0.083
2	0.00076	0.00123	0.0033	0.0064	0.0101	0.028	0.072
3	0.00011	0.00023	0.0007	0.0014	0.0027	0.007	0.018
4	0.01160	0.02129	0.0414	0.0973	0.3688	2.270	10.613
5	0.66268	2.83904	5.9546	10.9097	20.3673	62.184	222.995
6	1.40856	4.99394	13.4992	23.9668	40.6741	141.361	318.204
7	1.39642	5.40883	13.9394	22.0926	46.6855	142.746	230.019
8	1.13199	4.28806	8.1435	15.9948	28.5753	82.250	155.635
9	1.58024	4.14202	11.0075	21.1815	39.4004	115.429	398.093
10	0.76140	2.21512	6.2485	21.4291	48.6494	133.759	302.636
11	0.10170	0.19165	0.4095	0.8364	1.6510	3.681	8.046
12	0.06135	0.11344	0.2211	0.3100	0.4658	0.820	1.142
	9.17085	26.6412	65.6622	125.065	211.171	592.663	1545.60

NODE=1507 (SPOKANE)

MON	MIN	P5	Q1	MEDIAN	Q3	P95	MAX
1	0.00005	0.00010	0.00039	0.00083	0.00164	0.0050	0.0118
2	0.00001	0.00002	0.00005	0.00009	0.00018	0.0004	0.0008
3	0.00002	0.00003	0.00011	0.00026	0.00049	0.0024	0.0072
4	0.00143	0.00229	0.00503	0.00751	0.01089	0.0210	0.0486
5	0.00387	0.00711	0.01278	0.02150	0.03694	0.1282	0.3943
6	0.11790	0.35003	0.64828	1.35890	2.71564	10.7584	26.1243
7	0.13862	0.40221	0.94870	1.88331	3.46745	12.4256	32.4319
8	0.16430	0.38635	1.00148	1.93315	3.28957	11.6875	27.8972
9	0.32822	0.57017	1.68921	3.13333	5.05218	16.1120	33.9839
10	0.03355	0.12876	0.27846	0.43391	0.96867	2.4980	7.8488
11	0.01657	0.02664	0.05623	0.09233	0.16835	0.5441	1.3082
12	0.00157	0.00407	0.00700	0.01162	0.01885	0.0514	0.1335
	0.91460	1.81351	5.21221	9.39057	16.5175	47.5966	122.495

A "NORMAL" run

NODE=152 (BAKER)

MON	MIN	P5	Q1	MEDIAN	Q3	P95	MAX
1	0.000000	0.000000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.000000	0.000000	0.00000	0.00000	0.00000	0.00000	0.00000
3	0.000000	0.000000	0.00000	0.00000	0.00001	0.00005	0.00011
4	0.000000	0.000001	0.00000	0.00000	0.00001	0.00001	0.00003
5	0.000721	0.001481	0.00299	0.00873	0.01739	0.05220	0.10361
6	0.000456	0.001802	0.00480	0.01279	0.03470	0.15884	0.25929
7	0.000276	0.000525	0.00202	0.00458	0.01216	0.05457	0.18703
8	0.016289	0.085658	0.19606	0.38667	0.57103	1.53319	2.95884
9	0.015802	0.036054	0.08168	0.14575	0.23122	0.42731	0.71246
10	0.002597	0.005224	0.01314	0.02129	0.03824	0.14633	0.40335
11	0.000292	0.000450	0.00097	0.00185	0.00300	0.00726	0.01200
12	0.000027	0.000045	0.00010	0.00016	0.00025	0.00053	0.00104
	0.039188	0.19461	0.33873	0.66078	0.92734	1.97692	3.88051

NODE=962 (ELTOPIA)

MON	MIN	P5	Q1	MEDIAN	Q3	P95	MAX
1	0.00045	0.00073	0.0025	0.0060	0.0125	0.035	0.099
2	0.00085	0.00159	0.0033	0.0056	0.0085	0.019	0.113
3	0.00011	0.00029	0.0006	0.0013	0.0025	0.005	0.021
4	0.90935	0.02329	0.0446	0.0886	0.3442	1.990	4.556
5	1.66308	3.02322	6.3831	11.9468	19.6478	52.928	133.473
6	4.63007	6.07420	13.8641	25.5840	38.4434	106.434	143.334
7	3.71358	7.84408	14.4921	24.8133	44.4566	77.992	127.571
8	2.91512	5.55923	10.5278	15.8329	27.4038	49.305	74.756
9	3.75921	5.68392	11.2162	19.8668	35.6324	84.147	123.450
10	1.29470	2.28340	8.8610	20.4886	39.4405	88.546	139.758
11	0.19096	0.29325	0.5139	0.8637	1.2691	2.350	2.495
12	0.11928	0.15022	0.2216	0.2802	0.3506	0.453	0.583
	24.3464	42.5028	70.8212	128.546	202.503	465.628	639.343

NODE=1507 (SPOKANE)

MON	MIN	P5	Q1	MEDIAN	Q3	P95	MAX
1	0.00003	0.00009	0.00044	0.00073	0.00164	0.00287	0.0048
2	0.00002	0.00003	0.00005	0.00009	0.00014	0.00026	0.0006
3	0.00002	0.00004	0.00011	0.00025	0.00050	0.00124	0.0049
4	0.00240	0.00313	0.00453	0.00652	0.00905	0.01741	0.0418
5	0.00680	0.00837	0.01189	0.02058	0.03199	0.07323	0.2615
6	0.25542	0.47541	0.87783	1.48115	2.29127	6.90377	9.6467
7	0.29165	0.53678	1.11530	1.92392	2.98123	7.67500	15.5694
8	0.27899	0.64700	1.14060	1.86122	3.13343	7.02326	11.0839
9	0.59902	0.94104	1.87977	2.73614	4.67214	9.28041	16.3139
10	0.11925	0.18693	0.32664	0.45918	0.71093	1.58494	2.4336
11	0.03090	0.03603	0.06855	0.09734	0.13580	0.31287	0.6560
12	0.00288	0.00566	0.00788	0.01116	0.01554	0.03193	0.0774
	1.74933	3.52523	6.20618	8.65503	13.6939	32.6163	54.0926

TRANSFER FACTORS set to central value

NODE=152 (BAKER)

MON	MIN	P5	Q1	MEDIAN	Q3	P95	MAX
1	.0000000	0.000000	0.000000	0.00000	0.00000	0.00000	0.00000
2	.0000000	0.000000	0.000000	0.00000	0.00000	0.00000	0.00000
3	.0000000	0.000000	0.000000	0.00000	0.00001	0.00002	0.00006
4	.0000001	0.000000	0.000001	0.00000	0.00000	0.00000	0.00001
5	.0001204	0.000269	0.000675	0.00155	0.00402	0.01163	0.02381
6	.0000746	0.000321	0.001120	0.00244	0.00724	0.04487	0.12537
7	.0000446	0.000099	0.000380	0.00091	0.00276	0.01494	0.11990
8	.0064049	0.019965	0.058190	0.12446	0.24584	0.78725	2.19729
9	.0017180	0.011744	0.024312	0.04757	0.09489	0.22869	0.40952
10	.0006168	0.002074	0.005491	0.01295	0.02693	0.06710	0.13702
11	.0001052	0.000196	0.000529	0.00121	0.00267	0.00706	0.01280
12	.0000126	0.000019	0.000051	0.00011	0.00026	0.00053	0.00104
	.011216	0.044296	0.10237	0.19956	0.38699	1.26769	2.49888

NODE=962 (ELTOPIA)

MON	MIN	P5	Q1	MEDIAN	Q3	P95	MAX
1	0.00018	0.00030	0.00168	0.00377	0.0073	0.0211	0.0420
2	0.00039	0.00065	0.00158	0.00268	0.0046	0.0088	0.0198
3	0.00005	0.00008	0.00020	0.00053	0.0010	0.0027	0.0038
4	0.00848	0.01126	0.02611	0.05959	0.1363	0.4862	1.1977
5	0.22033	0.47089	1.17977	1.99178	3.0332	8.2427	12.5563
6	0.51502	1.01788	2.68195	4.32085	7.6512	14.1700	22.6481
7	1.09129	1.83168	4.86555	8.14542	14.3676	49.0111	72.3227
8	0.94619	1.37053	2.88999	5.60715	10.3375	23.8281	39.9523
9	0.77549	1.02776	2.84041	4.32369	6.9601	19.9132	28.8136
10	0.54491	1.41640	2.88503	6.23443	12.6941	25.5965	39.5881
11	0.09242	0.17892	0.38294	0.81357	1.6922	3.4961	7.9909
12	0.02967	0.07540	0.17965	0.24557	0.3457	0.6950	0.8562
	5.87989	7.20476	19.8473	34.6334	55.2962	139.300	175.225

NODE=1507 (SPOKANE)

MON	MIN	P5	Q1	MEDIAN	Q3	P95	MAX
1	0.000015	0.00004	0.00017	0.00034	0.00074	0.00171	0.00306
2	0.000006	0.00001	0.00002	0.00003	0.00005	0.00021	0.00029
3	0.000005	0.00001	0.00004	0.00011	0.00022	0.00051	0.00074
4	0.000647	0.00103	0.00232	0.00319	0.00470	0.00792	0.01254
5	0.001584	0.00286	0.00508	0.00881	0.01400	0.04916	0.25733
6	0.053574	0.08683	0.20596	0.35950	0.66065	1.50189	2.09749
7	0.052524	0.09236	0.21966	0.45520	0.69694	1.45404	2.39742
8	0.080050	0.11859	0.23794	0.47713	1.08264	2.19350	2.87926
9	0.095165	0.26035	0.65239	1.34425	2.35414	3.73826	6.13897
10	0.017527	0.08162	0.16255	0.28746	0.62382	1.21045	1.62862
11	0.012018	0.01846	0.04025	0.06589	0.12543	0.25917	0.41455
12	0.001157	0.00221	0.00488	0.00750	0.01304	0.02423	0.03731
	0.31609	0.81530	1.64030	3.16828	5.48651	8.99683	12.4655

DOSE FACTORS set to central value

NODE=152 (BAKER)

MON	MIN	P5	Q1	MEDIAN	Q3	P95	MAX
1	.0000000	0.000000	0.000000	0.00000	0.00000	0.00000	0.00000
2	.0000000	0.000000	0.000000	0.00000	0.00000	0.00000	0.00000
3	.0000000	0.000000	0.000000	0.00000	0.00000	0.00001	0.00001
4	.0000001	0.000000	0.000001	0.00000	0.00000	0.00000	0.00001
5	.0002119	0.000330	0.000852	0.00208	0.00323	0.00722	0.01319
6	.0001648	0.000575	0.001088	0.00209	0.00600	0.02226	0.05660
7	.0000832	0.000181	0.000358	0.00097	0.00278	0.01309	0.02334
8	.0062845	0.025224	0.073716	0.12801	0.23368	0.49640	0.60494
9	.0075922	0.015750	0.031244	0.05026	0.07084	0.12165	0.16437
10	.0020618	0.003308	0.007168	0.01341	0.02027	0.04601	0.06348
11	.0001211	0.000300	0.000686	0.00125	0.00213	0.00382	0.00806
12	.0000123	0.000030	0.000064	0.00012	0.00017	0.00030	0.00052
	.018531	0.057922	0.13501	0.21167	0.34952	0.59351	0.79484

NODE=962 (ELTOPIA)

MON	MIN	P5	Q1	MEDIAN	Q3	P95	MAX
1	0.00022	0.00040	0.00137	0.00326	0.0073	0.0164	0.0305
2	0.00041	0.00106	0.00185	0.00251	0.0034	0.0052	0.0080
3	0.00007	0.00010	0.00020	0.00045	0.0008	0.0018	0.0030
4	0.00619	0.01616	0.02926	0.05706	0.0956	0.3722	0.7743
5	0.51203	0.73356	1.29076	1.84948	2.4715	4.5539	6.6149
6	1.22208	2.01486	3.22217	4.62359	5.9929	8.6698	12.8515
7	1.68929	3.33065	5.74306	8.54410	11.0296	21.1176	33.0973
8	1.48418	2.48538	4.09745	5.88916	7.7400	10.7562	15.0055
9	1.56440	1.93877	3.12092	4.58401	6.2663	10.6169	19.0242
10	1.12907	1.80696	3.88269	6.37777	8.8719	17.4060	26.2743
11	0.17292	0.27066	0.49241	0.82968	1.2548	2.1959	2.4286
12	0.09631	0.13001	0.18383	0.22327	0.2689	0.3430	0.4955
	10.3903	15.6397	25.7314	33.3305	46.0873	68.6946	77.4800

NODE=1507 (SPOKANE)

MON	MIN	P5	Q1	MEDIAN	Q3	P95	MAX
1	0.00002	0.00005	0.00020	0.00038	0.00058	0.00104	0.00133
2	0.00001	0.00001	0.00002	0.00003	0.00005	0.00009	0.00015
3	0.00001	0.00001	0.00004	0.00010	0.00019	0.00033	0.00048
4	0.00150	0.00201	0.00246	0.00306	0.00355	0.00446	0.00532
5	0.00325	0.00481	0.00626	0.00813	0.00990	0.04255	0.14082
6	0.12136	0.15584	0.24377	0.37942	0.46780	0.75064	1.38414
7	0.14111	0.18536	0.30192	0.38985	0.56128	0.84346	0.95486
8	0.13127	0.21260	0.33745	0.48328	0.70681	1.31960	1.60674
9	0.35665	0.52051	0.86605	1.25519	1.67601	2.68841	3.37467
10	0.09129	0.13272	0.22140	0.29687	0.43368	0.90138	1.17743
11	0.02470	0.02788	0.04563	0.06601	0.09417	0.14827	0.19559
12	0.00238	0.00397	0.00534	0.00709	0.00922	0.01337	0.02156
	1.12565	1.42490	2.27488	2.90281	3.95880	5.82310	6.35587

DOSE FACTORS and TRANSFER FACTORS set to central values