A SENSITIVITY ANALYSIS AND IMPLEMENTATION REVIEW OF THE MOBILITY IMPROVEMENTS PRIORITIZATION METHOD

WA-RD 428.2

Appendices
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Washington State Department of Transportation

Washington State Transportation Commission
Planning and Programming Service Center
in cooperation with the U.S. Department of Transportation
Federal Highway Administration

APPENDIX A. PROJECT DESCRIPTION SHEETS, CRITERIA WORKSHEETS, AND SCORING GUIDELINES

PROPOSED MOBILITY IMPROVEMENT PROJECT DESCRIPTION

DISTRICT:_____
LOCAL JURISDICTION(S):_____
_____

SR:_____
PROJECT TITLE:_____
SR MILEPOST:_____ to SR MILEPOST_____
LENGTH:_____ (miles)

The purpose of the following descriptions is to identify the existing geometric characteristics of the project area, to detail the proposed improvements, and to describe the proposed future facility.

In each case, ***descriptions must address the following conditions:*** number, width, and type of lanes; shoulder, sidewalk, and bike lane width/existence; median width and type; interchange/intersection specifications; midpoint of expansion; safety measures (e.g. signalization, lighting, etc.); functional class; design speed; alignment changes; and right-of-way needs.
A ***map must be attached*** that highlights the project area and describes the section-township-range coordinates, distance from the nearest intersection, and names of roadways in the vicinity. Where the project proposal entails a new roadway/alignment or major intersection improvements, attach a secondary map &/or cross section at a larger scale.

Description of Existing Facility:

Description of Proposed Improvements and Future Facility:

Ranking relative to other proposed district project submittals?_____ of _____.

MOBILITY PRIORITIZATION CRITERIA

- **COST EFFICIENCY- Benefit-Cost Analysis for Safe Movement of People and Goods**

- **COMMUNITY SUPPORT**

- **ENVIRONMENT**
  - **Wetland Assessment**
  - **Water Quality and Permitting**
  - **Noise Assessment**

- **MODAL INTEGRATION**

- **LAND USE**

COST EFFICIENCY WORKSHEET -

Benefit-Cost Analysis for the safe movement of people and goods

The purpose of this worksheet is to summarize project costs and benefits. Detailed calculations should be included for each project and attached on a separate page. Benefits and costs should be expressed as present values using the following parameters:

Discount Rate (i) = 0.04
Study Period (n) = 20 years
(may vary on some projects, yet MUST be consistent with the time period used to calculate Project Benefits in any case. See accompanying outlines as detailed below.)

Project Cost Estimate: **199_ $'s**

Construction _____ (C)
(Sum ALL relevant line items including: environmental mitigation, and right-of-way; and excepting the following:)

Environmental Retrofit _____ (E_R)
(costs incurred due to a pre-existing condition, e.g. noise barriers, water quality treatment, and fish barrier removal. Some may be exempt.)

Preliminary Engineering _____ (S_P)

Annual Operating and Maintenance _____
(based on historical rates in similar area with proposed geometrics, except the following: Snow and Ice Removal, Structures & Ferries, Rest Area Management, and Public Damage Repair) (OpM_A)

Calculate the Present Value of Project Costs (PV_C):

$$PV_C = (C) + (E_R) + (S_P) + \left\{ OpM_A \left[\frac{(1+i)^n - 1}{i(1+i)^n} \right] \right\}$$

Total Est. Costs (PV_C) = _____

Project Benefit Estimate:

Present Value of User Benefits _____
(includes both Travel Time Savings & User Operating Savings. Calculate as outlined in accompanying "User Benefits Worksheets")

Present Value of Safety Benefits _____
(Calculate as outlined in accompanying "Safety Benefits Worksheets")

Total Est. Benefits (PV_B) = _____

Calculate the BENEFIT-COST RATIO of Proposed Project:

B/C = (PV_B) /(PV_C) = _____

COMMUNITY SUPPORT WORKSHEET

The purpose of this worksheet is to assess the community support and potential impact from the proposed project. For each question, check the appropriate answer and log score in the blank to the right.

Question		Score
1. Is local, regional, or TIB financial participation anticipated? **If yes,** identify and indicate scale by percentage of total project costs: < 10% _____ 10-25% _____ > 25% _____	___Yes No=3 If Yes, < 10% =2 10-25% =1 > 25% =0	_____
2. a. Have any local governments endorsed this project? (Identify):_____ _____ _____	Yes=0 No=3	_____
b. Have any local organizations endorsed this project? (Identify):_____ _____ _____	Yes=0 No=1	_____
3. a. Have any local governments indicated opposition? (Indicate scale): _____ _____ _____	___Yes No=0 If Yes, minimal=1 moderate=2 significant=3	_____ _____
b. Have any private groups or individuals indicated opposition? (Indicate scale): _____ _____ _____		_____ _____
4. Will the project divide identifiable neighborhoods, school or business service areas?	Yes=1 No=0	_____
5. Will this project displace homes, cultivated farmlands, or businesses? **If yes**, indicate scale of displacement: No. Homes/Farms/Businesses: Estimated Acreage: < 6 _____ _____ 6-20 _____ _____ > 20 _____ _____	___Yes No=0 If Yes, < 6 = 1 6-20 = 2 > 20 = 3	_____
a. Has an evaluation of the potential opposition of the displaced been conducted?	___Yes ___No	
TOTAL SCORE:		_____

WETLAND WORKSHEET:

The purpose of this worksheet is to assess the potential impact from the proposed project. For each question, check the appropriate answer or enter the appropriate acreage, and log score in the blank to the right.

Question			**Score**
1. Are there any wetlands within 300' from the edge of the present roadway?	____Yes No=0		_____
If yes, identify the Class and required buffer for each wetland. Note the total acerage that may be affected as a result of the proposed project below:			
Category 1	____No. of acres	(x6)=	_____
Category 2 or Category 3			
Forested	____No. of acres	(x3)=	_____
Scrub-Shrub	____No. of acres	(x2)=	_____
Emergent	____No.of acres	(x1.5)=	_____
Category 4	____No.of acres	(x1.25)=	_____
All Buffers	____No.of acres	(x1)=	_____
TOTAL SCORE : (if yes, minimum=0.5, if no, score=0.0)			_____

WATER QUALITY AND PERMITTING WORKSHEET:

The purpose of this worksheet is to assess the potential watershed impact and permitting requirements associated with the proposed project. For each question, check the appropriate answer or enter the appropriate acreage, and log score in the blank to the right. *If a required permit has already been obtained for the expected duration of the need, enter 0 pts and the date issued in the corresponding blank to the right.*

Question		Score
1. Will the project be located within 2000 feet of any body of water?		
If yes, then address the following:	___Yes No=0	_____
What will the total impervious surface area be upon completion of the proposed project (within 2000' of any water body)?	< 6 acres =1 6-20 acres =2 > 20 acres =3	_____
Will the project require hydraulic permits (HPA's)?	Yes=4 No=0	_____
Is there a known fish passage problem?	Yes=1 No=0	_____
Will the project require COE Section 10, 404, or Coast Guard Section 9 permit?	Yes=5 No=0	_____
Will the project require Shoreline Development permits?	Yes=4 No=0	_____
Is the project located within a Shoreline of Statewide Significance?	Yes=1 No=0	_____
Will any water quality permits be required (ie., NPEDS, Short Term Modification of Water Quality Standards)?	Yes=4 No=0	_____
Is the project a new roadway?	Yes=1 No=0	_____
2. Have any adjacent areas been identified as sensitive/critical by one or more governing juridictions? (Identify:)_____	Yes=5 No=0	_____
3. Is the project located within a regulatory floodway?	Yes=4 No=0	_____
4. Will the project increase impervious surface area within an EPA designated sole source aquifer area? (Identify:)_____	Yes=2 No=0	_____
5. Will this project require the purchase of additional right-of-way, or use of existing right-of-way?	___Yes No=0	_____
If yes, is the project located within:		
Forest Lands as defined by Dept. of Natural Resources?	Yes=4 No=0	_____
U.S. Forest Service National Forest jurisdiction?	Yes=1 No=0	_____
Other jurisdiction/resource lands of regional significance? (Identify:)_____	Yes=2 No=0	_____
	SUBTOTAL:	_____
If permitting agencies have been contacted, are there any foreseeable conflicts or disagreements?	___Yes ___No ___ Unknown or not applicable	if no, divide subtotal by 2.
	TOTAL SCORE:	_____

NOISE WORKSHEET:

The purpose of this worksheet is to assess the potential noise impact and associated costs due to the proposed project. For each question, check the appropriate answer or enter the appropriate number of residences, and log score in the blank to the right.

Question **Score**

1. Have existing noise impacts been identified along the proposed project distance? ___Yes ___No

   If yes, include the cost of feasible and reasonable mitigation measures in the project cost estimate, or cite determination otherwise:_____

2. Is this project a new or existing alignment? ____New ____Existing

   If new, evaluate the number of receptors within **400'** of the edge of the proposed roadway. Go to question #4.

   If existing, go to question #3.

3. Does the proposed project include widening of an existing roadway? ___Yes ___No

   If yes, evaluate the number of receptors within **200'** of the edge of the proposed roadway. Go to question #4.
   If no, go to question #5, enter 0 in the blank to the right.

4. Refer to the chart below, and compute the project score as follows: Divide the number of lanes that will be added/constructed by 2. Multiply the result by the number of receptors in each distance category and by the appropriate risk factor (for New *or* Existing alignment per question #2) for each receptor category as indicated below.

No. of lanes added or constructed / 2	Receptor Category	Number of Receptors	Noise level risk factor (r.f.): NEW	EXISTING	SUBTOTAL = (No. lanes/2) * (No. receptors) * (r.f.)
	< 100'		4	2	
	101-200'		2	1	
	201-400'		1		

5. Sum the results (Subtotals) for each category and enter the total project score in the blank to the right. **TOTAL SCORE:** _____

MODE INTEGRATION WORKSHEET

The purpose of this worksheet is to assess the level of modal integration supported by the proposed project. For each question, check the appropriate answers and log score in the blank to the right.

Question		Score
1. Does the proposed project increase mobility using existing capacity (e.g., access control, TDM/TSM, GP=>HOV conversion, frontage road improvement)?	Yes=0 No=1	_____
2. Does the project improve or facilitate linkage for movement of goods through port or terminal facilities (i.e., multimodal land-based, rail/trucking; waterborne; airborne)?	Yes=0 No=1	_____
3. Is the project, or does the project include, a designated HOV transfer area (e.g., park and ride lots, sheltered turnouts, flyer stop)?	Yes=0 No=1	_____
4. Does the proposed project improve integration between existing HOV facilities and connecting arterials (e.g., improved on or off ramp transitions, improvements to HOV termini)?	Yes=0 No=2	_____
5. Does the proposed project link or extend to existing HOV lanes?	Yes=0 No=2	_____
6. Is the project, or does it include, facilities designed to encourage use of bicycles with other modes or encourage bicycle use (e.g., bike carriers on buses, loop detectors or lane designations at intersections, storage facilities at park and rides)?	Yes=0 No=1	_____
7. Does the project link or extend existing or planned bikeways?	Yes=0 No=1	_____
8. Does the proposed project link or extend existing or planned pedestrian facilities, &/or include additional pedestrian amenities?	Yes=0 No=1	_____
	TOTAL SCORE:	_____

LAND USE WORKSHEET:

The purpose of this worksheet is to assess the current land use and local planning/transportation policies, plans, and implementation measures of the governing jurisdictions concerned with the proposed project area. For each question, check the appropriate answer or enter the appropriate response, and log score in the blank to the right.

Question **Score**

1. Is the project included in the Comprehensive and/or Transportation Plan of any of the following? (If so, identify by name):

Regional Transp. Planning Org. :_____

Other regional planning agency :_____

County &/or City government :_____

:_____

Other local interests/agencies :_____

2. Do all the local governments having an interest in the project include it in their plans as identified above? Yes=5 No=0 _____

If no, has any action been taken by each of the appropriate planning agencies to approve the project? Yes=5 No=0 _____

Indicate the action by what agency(cies):_____

_____

_____

3. Has the *"Land Use Policy and Implementation"* file for local governments been updated in each jurisdiction that this project passes through? Yes= 5 No=0 _____

4. Is the project on a roadway that directly links two or more designated growth centers? Yes= 3 No=0 _____

5. Is the project located on an established or planned transit line/route? Yes= 1 No=0 _____

TOTAL SCORE: _____

SCORING GUIDELINES

November 15, 1993

COMMUNITY SUPPORT:

Scoring:

- #3. Score the scale of opposition referenced by common extremes: minimal=1 to 2 individuals or a group without substantial support; significant=mobilized opposition substantial enough to seriously threaten the success of the project.
- #5. Score only the scale of displacement by number of homes/farms/businesses displaced. Acerage estimation is additional information in the scoping process.
- #5a. No score is assigned. The question serves as a procedural checklist for completing the project cost estimate.
- Total Score = sum each score entered in the column to right.

Definitions:

- "Divide identifiable neighborhoods, schools, business service areas"- Subject to local plans/existing conditions this may become an affirmative response in the case of substantial widening projects, access restrictions, or barrier separated facilities. Refer to historical local response and community plans where available.

WETLANDS:

This worksheet is intended to prompt a paper inventory of wetland resources for each project area. The values are based on the body of federal, state, and local regulations related to wetland preservation. Most notably, concurrent with WSDOT [*Environmental* 1993:3-2-1A] and other state agency procedures, the "Washington State Four-tier Rating System, September 1, 1990" is used as the worksheet framework and the replacement ratios for compensatory mititgation outlined in *The Model Wetlands Protection Ordinance*, Washington State Department of Ecology are applied. The required band of analysis (300') is also based on the body of literature and adopted ordinances which establish wetland buffers ranging from 25-300' statewide. These buffers are also subject to a 1:1 replacement ratio in RCW 36.70A mandated local regulations statewide, as reflected on the worksheet.

Refer to the *District Resource List* for local inventory information and see the enclosed outline of the "Washington State Four-tier Rating System, September 1, 1990".

Scoring:

- Evaluate the acerage of the footprint of proposed construction encroachment into an inventoried wetland area &/or the associated buffers only.
- When the equivalent Four-tier Category of a wetland is unknown, use the "Category 2 Forested" replacement ratio.
- Total Score = sum each score entered in the column to right.

- If there are ANY wetlands that may be affected as defined above, the minimum Total Score=0.5 acres regardless of the area of encroachment. If there are NO wetlands or buffer areas affected as defined above, the Total Score=0.0 acres.

Definitions:

- "wetlands"- lands that are either permanently or seasonally "inundated by surface or ground water with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction." (Presidential Executive Order 11990). [*Environmental* 1993:3-2-1A]

WATER QUALITY AND PERMITTING:

Scoring:

- Refer to the WSDOT Environmental Procedures Manual 6.0-6.9, March 1990 to evaluate permit requirements for the proposed project. (*Environmental* 1993)
- Total Score = subtotal of each score entered in the column to right subject to the final operation as noted on the worksheet.

Definitions:

- "body of water"- All inter/intrastate waters within the ordinary high water line such as lakes, rivers, streams (including intermittent streams), mudflates, sand-flats, wetlands, sloughs, prairie pot-holes, wet meadows, playa llakes, or natural ponds, including all waters which are subject to the ebb and flow of the tide (ending where the rise and fall of the water surface can no longer be pratically measured in a predictable rhythm due to masking by hydrologic, wind, or other effects).
- "total impervious surface area"- The total surface area of the roadway upon completion of the proposed project (i.e., width including the improvements * length of the roadway segment within 2000' of any water body).
- "Hydraulic Project"- Construction or other work that will use, divert, obstruct, or change the natural flow or bed of any river or stream, or that will utilize any of the salt or fresh waters of the state, or materials from the stream beds (WAC 220-110-020(16)).
- "fish passage problem"- Any migration barrier condition that exists when adult &/or juvenile fish are either delayed or denied passage beyond a point in a stream system or marine shallow water habitats during the normal course of their migration for spawning or rearing purposes. If fish are delayed from reaching suitable spawning areas, mass spawning or spawning in unsuitable substrate can occur, resulting in a decrease in survival. [WDF/WDW/DOT MOU (GC9058), & WDF/DOT State Interagency Agreement for Fish Passage Inventory & Barrier Removal (GC9392).]
- "Shoreline of Statewide Significance"- water areas of the state, including reservoirs, and their associated wetlands, including lands within 200 feet of the high-water mark

including associated marshes, bogs, swamps, floodways, riverdeltas, and flood plains for which there is a special interest in preserving the natural characteristics and in encouraging and increasing public access to enjoy the physical and aesthetic qualities of the natural shoreline with the overall best interest of the state and people generally being considered. The restriction for development is greater because the master plan must meet the requirements of RCW 90.58.020 (see RCW 90.58.030 for list).

- "new roadway"- project construction along a new alignment.
- "Sensitive/Critical"- designation subject to definition by the local governing authorities under SEPA, GMA, or zoning code implementation.
- "governing jurisdiction"- The public agency, political unit, or apparatus with administrative powers to command, determine, judge, or otherwise enforce the laws, public policy and affairs within the proposed project area.
- "regulatory floodway"- the area regulated by federal, State or local requirements to provide for the discharge of the base flood (the flood which has a one percent chance of being equalled or exceeded in any given year, a.k.a 100-year floodplain) so the cumulative increase in water surface elevation is no more than a designated amount (not to exceed one foot). The "Zone A" designation on the *Flood Insurance Rate Maps* by the Federal Emergency Management Agency, indicates the 100-year floodplain, or minimum level to be used by a community in its floodplain management regulations. (44 CFR Ch.I 9.4)
- "sole source aquifer area"- area designated by the EPA as the sole or principal source of drinking water for a given aquifer service area; that is, an aquifer which is needed to supply 50% or more of the drinking water for that area and for which there are no reasonably available alternative sources should the aquifer become contaminated. (Section 1424(e) of Safe Drinking Water Act, 1974)
- "Forest Land"- all land that is capable of supporting a merchantable stand of timber (a stand of trees that will yield logs &/or fiber suitable in size and quality for the production of lumber, plywood, pulp, or other forest products and of sufficient value at least to cover all the cost of harvest and transportation to available markets) and is not being actively used for a use which is incompatible with timber growing. (RCW 76.09.020, WAC 222)
- "Other jurisdictions/resource lands of regional significance"- areas including but not limited to: tribal governments, reservation lands, regulatory commissions (e.g., Columbia River Gorge Commission), significant/endangered wildlife corridors, prime/unique farmlands, archaeological/historical sites, National Park lands, other recreation land, and wild and scenic rivers that have been identified in the planning process as outlined in the Environmental Procedures Manual 3.0-3.12, March 1990. (*Environmental* 1993).

NOISE:

The intent of this worksheet is that it be carried out in-house using aerial photographs of the right-of-way and the table provided on the worksheet.

Scoring:

- Determine whether there are existing noise impacts over 67dBA level that would require mitigation where feasible and reasonable (see definition below). Cost of mitigation measures MUST be included in the cost estimate EXCEPT where mitigation has been previously determined 'unfeasible' or 'unreasonable' by WSDOT procedures. This determination must be referenced on the worksheet in the space provided and is the only justifiable reason for not including these potential costs in the estimate.
- If the proposed project is on a *new alignment* evaluate the number of receptors within 400' of the edge of the existing roadway.
- If the proposed project will **widen** the roadway along the *existing alignment*, evaluate the number of receptors within 200' of the edge of the existing roadway.
- Working with aerial photographs of the area, group the number of receptors with respect to distance from the edge of proposed roadway as categorized on the worksheet chart. If new, <100', 101-200', 201-400'; if existing, <100', 101-200' ONLY).
- Using the Noise Level Risk Factors in question #4, compute the subtotals as follows: Divide the number of lanes that will be added/constructed by 2. *This result will be the same for each Receptor Category.* Multiply the result by the number of receptors in each distance category and by the appropriate risk factor. Apply only *one* risk factor to each Receptor Category from either the new *or* existing alignment column in the worksheet chart.
- Add the Subtotals in the right-hand column of the worksheet chart and log the Total Score in the blank provided.

Definitions:

- "exisiting noise impacts"- Noise priority sites as established by WSDOT Directive D 22-22, November 2, 1987. Guidelines are detailed for conducting a noise inventory for existing state highways. The priority listing was developed based on an inventory of noise sensitive developments which existed, or for which a building permit had been approved, prior to May 14, 1976 and is current as of August 19, 1986 in Appendix A. As new sites must be investigated, because of citizen complaints or public officials' concerns, the procedures in this Directive will be used to prioritize the new sites. More comprehensive or up-dated inventories may have been conducted by individual districts, check with environmental noise specialists. (*Environmental* 1993:3.1, pub.March 1990)
- "feasible mitigation"- Noise mitigation that has no overwhelmingly significant physical constraints to construction and will provide significant noise abatement for

some of the impacted receptors. Refer to WSDOT Headquarters Environmental division for specific parameters.

- "reasonable mitigation"- Noise mitigation that will cost $\leq$ $10,500/residence, not withstanding scenic views, desireablity, and other consideration. Refer to WSDOT Headquarters Environmental division.

MODE INTEGRATION:

Scoring:

- Total Score = Sum of each score entered in the the column to the right.

Definitions:

- "improve or facilitate linkage for movement of goods through port or terminal facilities"- The proposed project must facilitate the movement of goods along a roadway with high truck traffic (for roadway classifications by truck percentage, Refer to "Task B: Freight and Goods Transportation System; Cost Responsibility Study-Phase I", Final Report for the St of WA Legislative Transportation Commission, January 1993.) and be within a ten mile radius from the terminal facility.
- "increased mobility"- used here to indicate conditions of greater movement of people and/or goods along the main roadway than presently supported by the facility.
- "bikeway"- Includes all four bikeway classes described by WSDOT Design Manual Standards.

LAND USE:

Scoring:

- Total Score = Sum of each score entered in the the column to the right.

Definitions:

- "local governments having an interest"- Those counties/cities where the proposed project a
- "*Land Use Policy and Implementation* file"- reference to a DOT District specific library of up-to-date documents, long-range transportation policies, and implementation measures for each city or county government encompassed by the District planning area. Each file must contain the following elements to enter a score of 5 points: *Land Use Checklist*, Comprehensive Plan, Transportation Plan, Zoning Code, Road/Design Standards, Critical Areas/Sensitive Areas Code/Ordinance, and other supporting inter-local, regional, &city/county-wide policy documents.
- *"Land Use Checklist"*- Form used to facilitate distillation of the governing jurisdiction's codes and policies. Intended for use as a procedural checklist, only categorical completion of this form (yes/no) is scored. See blank form attached.

- "designated growth center"- An area designated by regional or local planning agencies to receive a major share of the regional employment growth in the future.

LAND USE CHECKLIST

Indicate the specific zoning code/ordinances, comprehensive plan, transportation plan, road/design standards, or other adopted policy documents that implement each policy described below:

Policy	**Citations:**
a. Requires sidewalks as part of site planning.	
b. Requires/Encourages integrated bikeways or bicycle systems/facilities.	
c. Requires transit coordination for major residential, commercial, or retail development projects. (e.g., Bus turnouts, Sheltered passenger waiting facilities, etc.).	
d. Allows trade-offs between parking requirements and TDM measures.	
e. Requires/Encourages Clustering of major buildings	
f. Requires/Encourages physical orientation of major buildings to facilitate transit use.	
g. Requires Large-scale developments to integrate preferential lane treatment in their site design.	
h. Promotes measures to minimize impacts from development of adjacent land on roadway capacity (e.g., requiring combined driveways where possible, rear access, one-way drives, etc.).	
i. Other exceptional policies as appropriate: _____ _____	

APPENDIX B. MATHEMATICAL SUMMARY OF TOPSIS

MATHEMATICAL SUMMARY OF TOPSIS[1]

One of the most frequently used methods for prioritizing elements (i.e., projects) with disparate units is called technique for order preference by similarity to ideal solution (TOPSIS), which was developed by Hwang and Yoon based on the concept of Euclidean distance. The algorithm uses one project that has the weighted minimum Euclidean distance as the ideal solution and assumes that each criterion has a monotonically increasing (or decreasing) utility. The "ideal project" is composed of all of the best criteria values, and the "negative-ideal project" has all of the worst criteria values. The method compares the Euclidean distance of each criterion to both the ideal and the negative-ideal solutions simultaneously by taking the relative closeness to this ideal solution, thus, the priority of each project is obtained.

Figure B-1 shows an example of the Euclidean distances to the ideal and negative-ideal solutions in two dimensional space. A^* is the ideal project, A^- is the negative-ideal project. In the figure, project A_1 has shorter distances both to the ideal project A^* and to the negative-ideal project A^-, than the other project A_2. To justify the selection of projects, TOPSIS compares the relative closeness to the ideal solution by considering the two distances at the same time.

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[1] Hwang, Ching-Lai and Yoon, Kwangsun. (1981). *Lecture Notes in Economics and Mathematical Systems*. Springer-Verlag Berlin Heidelberg New York.
Note: Contents of this appendix were also previously published by Niemeier et al. (1995).

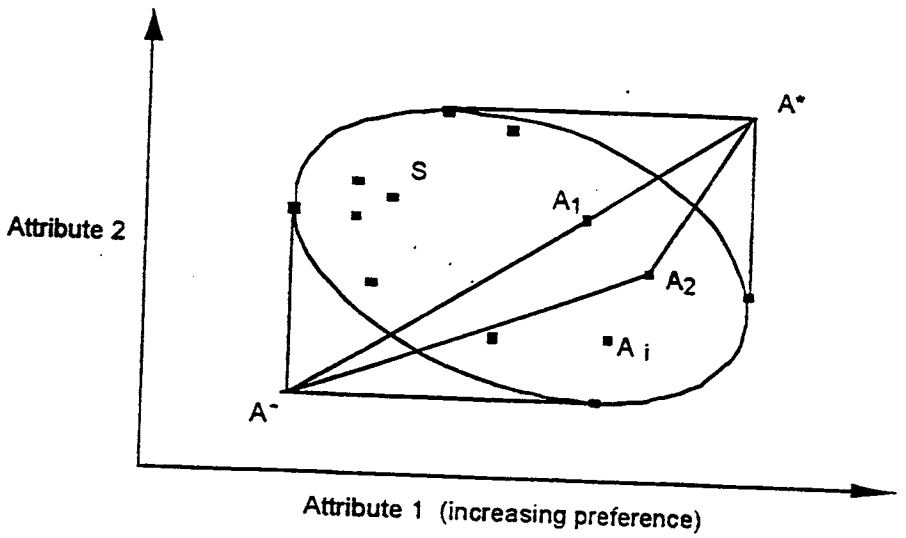


Figure B-1. Euclidean Distance to the Ideal and Negative-ideal Solutions in Two Dimensional Space

ANNOTATED ALGORITHM

The TOPSIS method evaluates m projects through n criteria, which make up the following decision matrix:

$$D = \begin{array}{c} \\ X_1 \\ X_2 \\ \vdots \\ X_i \\ \vdots \\ X_m \end{array} \begin{array}{c} \begin{array}{cccccc} B_1 & B_2 & & B_j & & B_n \end{array} \\ \begin{bmatrix} D_{11} & D_{12} & \cdots\cdots & D_{1j} & \cdots\cdots & D_{1n} \\ D_{21} & D_{22} & \cdots\cdots & D_{2j} & \cdots\cdots & D_{2n} \\ \vdots & \vdots & & \vdots & & \vdots \\ D_{i1} & D_{i2} & \cdots\cdots & D_{ij} & \cdots\cdots & D_{in} \\ \vdots & \vdots & & \vdots & & \vdots \\ D_{m1} & D_{m2} & \cdots\cdots & D_{mj} & \cdots\cdots & D_{mn} \end{bmatrix} \end{array}$$

where X_i = the ith project considered,

B_j = the jth criteria considered in the decision, and

D_{ij} = the numerical outcome of the ith project with respect to jth criteria.

Next, TOPSIS uses a set of weights obtained from decision makers to describe the importance of each criterion. It assumes the larger the attribute outcomes, the greater the benefit criteria and the less preferable the cost criteria. It consists of the following steps:

Step 1 Construct the normalized decision matrix (R). This process transforms the various criteria dimensions into non-dimensional criteria, which allows comparison across the different criteria. An element r_{ij} of the normalized decision matrix R can be calculated as:

$$r_{ij} = \frac{D_{ij}}{\sqrt{\sum_{i=1}^{m} D_{ij}^2}} \qquad \text{(B.1)}$$

Step 2 Construct the weighted normalized decision matrix (V). A set of weights $W = (W_1, W_2, \ldots\ldots, W_j, \ldots\ldots W_m)$ are accommodated into the decision matrix. The weights should sum to one, that is $\sum_{j=1}^{n} W$. The updated weighted matrix can be calculated by multiplying each column by its associated weight:

$$v_{ij} = r_{ij} * W_j \qquad \text{(B.2)}$$

Step 3 Determine ideal and negative-ideal solutions: Let the ideal solution A^* and the negative A^- be defined as:

$$A^* = \{ (\max_i v_{ij} \mid j \in J), (\min_i v_{ij} \mid j \in J') \mid i = 1,2, \ldots\ldots,m) \}$$

$$= \{ v_1^*, v_2^*, \ldots\ldots v_i^*, \ldots\ldots v_n^* \} \qquad \text{(B.3)}$$

$$A^- = \{ (\min_i v_{ij} \mid j \in jJ), (\max_i v_{ij} \mid j \in J') \mid i = 1,2, \ldots\ldots,m) \}$$

$$= \{ v_1^-, v_2^-, \ldots\ldots v_i^-, \ldots\ldots v_n^- \} \qquad \text{(B.4)}$$

where $J = \{ j = 1,2, ..., n \mid j$ associated with benefit criteria$\}$

$J' = \{ j = 1,2, ..., n \mid j$ associated with benefit criteria$\}$.

Step 4 Calculate the separation measure. The separation between each project can be measured by the n-dimensional Euclidean distance. The distance of each project from the ideal one is then given by

$$S_i^* = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^*)^2}, \qquad i = 1, 2, ..., m \qquad \text{(B.5)}$$

Similarly, the distance from the negative-ideal one is given by

$$S_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2}, \qquad i = 1, 2, ..., m \qquad \text{(B.6)}$$

Step 5 Calculate the relative closeness to the ideal solution. The relative closeness of A_i with respect to A^* is the priority of each project, which is defined as:

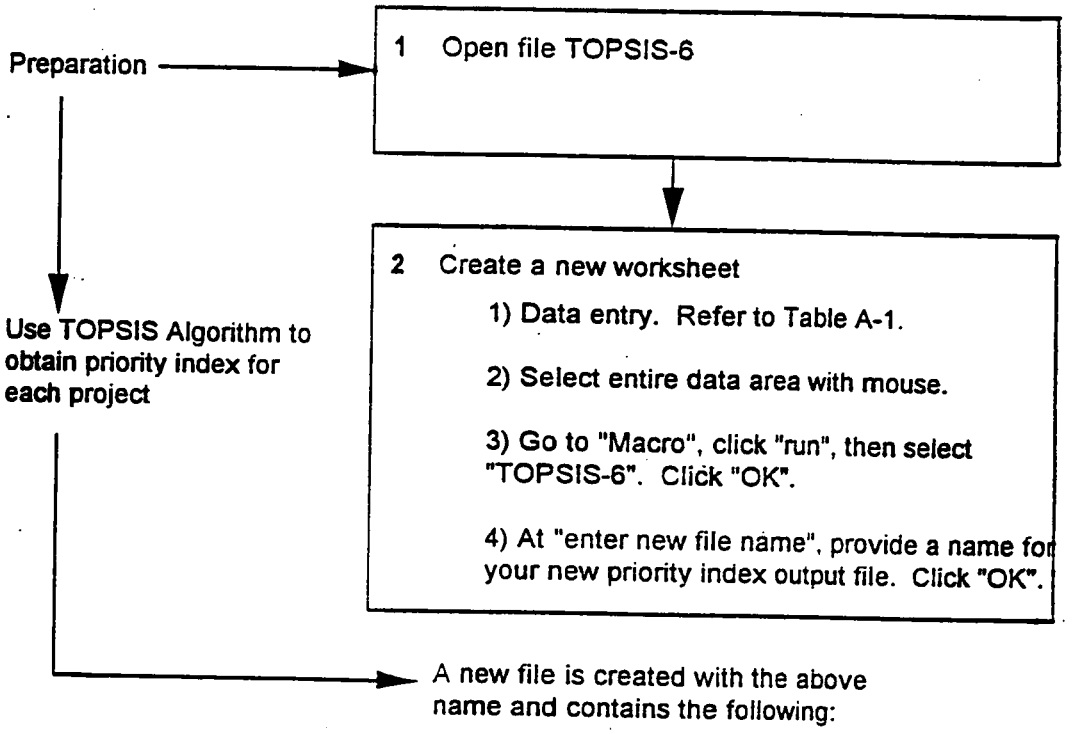
$$p_i^* = S_i^- / (S_i^* + S_i^-), \quad 0 < p_i^* < 1, \quad i = 1, 2, ..., m \qquad \text{(B.7)}$$

Step 6 Rank the priority order. A set of projects can now be priority ranked according to the descending order of p_i^*.

APPENDIX C. TOPSIS-6 ILLUSTRATION AND ANNOTATED CODE

PROGRAM INSTRUCTIONS
(Refer to Figure C-1 and Table C-1)

Step 1	Open TOPSIS-6 macro file from the directory.
Step 2	Open the data file containing projects and evaluation criteria values. This data file must be formatted as shown in Table A-1. Column 1 is used for the project identification (project identification can be any alpha-numeric combination). Columns 2 through 2+y are reserved for the evaluation criteria, where y=x-1 and x=Project Cost Column. Row 2 of the data sheet must include a weight for each evaluation criteria. The sum of the weights must equal 1.00. Row 3 is used to denote whether the criteria should be maximized or minimized. A "1" is used when high values are favored over low values. e.g., B/C and Land Use scores. A "0" is used when low values are favored over high values. e.g., environmental impact criteria.
Step 3	Highlight (select) the entire data set area exactly with the mouse.
Step 4	Go to "Macro" on the main menu and select TOPSIS-6. The program will display interim calculations to the right of the selected worksheet area. Be sure that you have saved the input worksheet prior to running the program. At the prompt, enter the name of a new file to which the output should be written. At the second prompt in the new worksheet, enter the program budget as indicated. Use the same units as were input for project costs previously. TOPSIS-6 will figure the project list that can be funded given the budget scenario in exact rank order and display the remaining funds in the third column, row five. When the program is complete, a window will display a notice as an indicator. Enter "OK".
Step 5	After the macro has completed execution, close the input data file and the TOPSIS-6 macro file; do NOT save any changes. Next, save the output file including changes and proceed to view the project priority indices in rank order. In order to format the output file, it must be saved under a different name before customizing the document.



Priority Index	Project I.D.	Project Cost	Budget	Project I.D.	Project Cost
0.893	1-01	28,000	75,000	1-01	28,000
0.767	1-02	18,500	Remainings	1-02	18,500
0.725	1-03	24,200	4,300	1-03	24,200
0.642	1-04	32,100			
0.509	1-05	5,480			
...	...	...			

Figure C-1. Application Procedure

Table C-1. Data Input Format

Project	B/C	Commun-ity Support	Wetlands	Water Quality	Noise	Modal Integrat-ion	Land Use
Weight	0.65	0.14	0.026	0.026	0.026	0.07	0.06
Max/Min	1	0	3.0	0	0	0	1
1-01	11.31	2	0.5	21	36	4	12
1-02	10.2	5	8	10	20	5	15
...	...	...	...	...	...	...	...

TOPSIS - 6 ANNOTATED CODE

A1. Topsis (t)

Start of the macro

A2. =SET.NAME("range",SELECTION())

Give the highlighted data area a name as "range"

A3. =ROWS(range)

Return the number of rows in "range"

A4. =COLUMNS(range)

Return the number of columns in "range"

A5. =SET.NAME("temp",OFFSET(range,0,A4+1)

Return a reference of the same size and shape as "range", with its upper-left corner shifted horizontally by the number of column of "range" (A4) plus 1. And give this shifted reference a name as "temp"

A6. =SET.NAME("workspace",INDEX(temp,4,2):INDEX(temp,A3,A4-1))

Give the area from row4-col2 in "temp" to rowA3-colA4 in "temp" a name as "workspace"

A7. =SET.NAME("origin",INDEX(range,4,2):INDEX(range,A3,A4-1))

Give the area from row4-col3 in "range" to row A3-colA4-1 in "range" a name as "origin"

A8. =SET.NAME("weight",INDEX(range,2,2):INDEX(range,2,A4-1))

Give the area from row2-col2 in "range" to row2-colA4-1 in "range" a name as "weight"

A9. =SET.NAME("logic",INDEX(range,3,2):INDEX(RANGE,3,A4-1))

Give the area from row3-col2 in "range" to row3-colA4-1 in "range" a name as logic

A10. =SET.NAME("sum1",INDEX(workspace,1,1):INDEX(workspace,1,A4-2))

Give the area from row1-col1 in "workspace" to row1=colA4-2 in "workspace" a name as "sum1"

A11. =SET.NAME("sum",OFFSET(sum1,A3-2,0))

Return a reference of the same size and shape as "sum1", with its upper-left corner shifted vertically by the number of A3 minus 2. And give this shifted reference a name as "sum"

A12. =SET.NAME("positive",OFFSET(sum,1,0))

Return a reference of the same size and shape as "sum", with its upper-left corner shifted vertically by one row. And give this shifted reference a name as "positive"

A13. =SET.NAME("negative",OFFSET(positive ,1,0))

Return a reference of the same size and shape as "positive", with its upper-left corner shifted by one row. And give this shifted reference a name as "negative"

A14. =SET.VALUE(A22,1)

Start outer loop. Initialize the counter at cell A22 to 1

A15. =SET.VALUE(A17,0)

Intialize the value of A17 to 0

A16. =SET.VALUE(A18,1)

Start inner loop. Intialize the counter at cell A18 to 1

A17. =A17+INDEX(origin,A18,A22)^2

Calculate the sum of squares of each cell in the first column of "origin", and repeat for all the columns

A18. =A18+1

Increment the inner loop counter A18

A19. =IF(A18<(A3-2),GOTO(A17))

The inner loop ends when all the rows in each column of "origin" are reached

A20. =SELECT(INDEX(sum,1,A22))

Select the cell of row1-colA22 in "sum"

A21. =FORMULA(A17)

Write the result of A17 to the above selected cell

A22. =A22 + 1

Increment the outer loop counter A22

A23. =IF(A22<A4-1,GOTO(A15))

The outer loop terminates when all the columns in "origin" are reached

A24. =SET.NAME("ido",INDEX(range,4,1):INDEX(range,A3,1))

Give the area from row4-col1 to row A3-col1 in "range" a name as "ido"

A25. =SET.NAME("costo",INDEX(range,4,A4):INDEX(range,A3,A4))

Give the area from row4-colA4 to row A3-colA4 in "range" a name as "costo"

A26. =SET.NAME("dummy",INDEX(workspace,1,1):INDEX(workspace, A3-3,1))

Give the area from row1-col1 to rowA3-3-col1 in "workspace" a name as "dummy"

A27. =SET.NAME("sep",OFFSET(dummy,0,A4))

Return a reference of the same size and shape as "dummy", with its upper-left corner shifted horizontally by the number of A4. And give this shifted reference a name as "sep"

A28. =SET.NAME("sepn",OFFSET(dummy,0,A4+1))

Return a reference of the same size and shape as "dummy", with its upper-left corner shifted horizontally by the number of A4 plus 1. And give this shifted reference a name as sepn"

A29. =SET.NAME("ci",OFFSET(dummy,0,A4+2))

Return a reference of the same size and shape as "dummy", with its upper-left corner shifted horizontally by the number of A4 plus 2. And give this shifted reference a name as "ci"

A30. =SET.NAME("id",OFFSET(ci,0,1))

Return a reference of the same size and shape as "ci", with its upper-left corner shifted horizontally by one row. And give this shifted reference a name as "id"

A31. =SET.NAME("cost",OFFSET(ci,0,2))

Return a reference of the same size and shape as "ci", with its upper-left corner shifted horizontally by two rows. And give this shifted reference a name as "cost"

A32. =SET.VALUE(A51,1)

Start outer loop. Initialize the counter at cell A51 to 1

A33. =SET.VALUE(A37,1)

Start inner loop. Initialize the counter at cell A37 to 1

A34. =SELECT(INDEX(workspace,A37,A51))

Select the cell of row A37-colA51 in "workspace"

A35. =INDEX(origin,A37.A51)/SQRT(INDEX(sum,1,A51))*INDEX(weight,1,A51)

Construct the weighted normalized matrix. (see Steps 1&2 of TOPSIS)

A36. =FORMULA(A35)

Write the result of A35 to the above selected cell

A37. =A37 + 1

Increment the inner loop counter A37

A38. =IF(A37<A3-2.GOTO(A34))

Repeat the above calculations until all the rows in "workspace" are reached. End of Steps 1&2 of TOPSIS

A39. =MAX(INDEX(workspace.1.A51):INDEX(workspace,A3-3.A51))

Return the largest number in the list from row1-colA51to row A3-3-colA51 in "workspace"

A40. =MIN(INDEX(workspace.1,A51):INDEX(workspace,A3-3,A51))

Return the smallest number in the list from row1-colA51 to row A3-3-colA51 in "workspace"

A41. =IF(INDEX(logic,1,A51)=0.GOTO(A47))

If the value of cell row1-colA51 in "logic" is 0. gotoA47. This corresponds to the case of minimization in TOPSIS Step 3. When its value is 1. goto next step A42. This corresponds to the case of maximization in TOPSIS Step 3

A42. =SELECT(INDEX(positive.1.A51))

Select the cell of row1-colA51 in "positive"

A43. =FORMULA(A39)

Write the value of A39 to the above selected cell

A44. =SELECT(INDEX(negative.1.A51))

Select the cell of row1-colA51 in "negative"

A45. =FORMULA(A40)

Write the value of A40 to the above selected cell

A46. =GOTO(A51)

End of maximization case

A47. =SELECT(INDEX(positive,1,A51))

Select the cell of row 1-colA51 in "positive"

A48. =FORMULA(A40)

Write the value of A40 to the above selected cell

A49. =SELECT(INDEX(negative,1,A51))

Select the cell of row1-colA51 in "negative"

A50. =FORMULA(A39)

Write the value of A39 to the above selected cell. End of minimization case

A51. =A51+1

Increment the outer loop counter of A51

A52. =IF(A51<A4-1,GOTO(A33))

End of Step 3 of TOPSIS

A53. =SET.VALUE(A84,1)

Start of outer loop, initialize the counter A84 to 1

A54. =SET.VALUE(A63,0)

Initialize A63 to 0

A55. =SET.VALUE(A65,0)

Initialize A65 to 0

A56. =SET.VALUE(A68,0)

Initialize A68 to 0

A57. =SET.VALUE (A70,0)

Initialize A70 to 0

A58. =SET.VALUE(A71,0)

Start of inner loop, initialize the counter A59 to 0

A59. =SET.VALUE(A74,0)

Intitialize A74 to 0

A60. =SET.VALUE(A75,0)

Initialize A75 to 0

A61. IF((AND(INDEX(positive.1,A71)>0,INDEX(workspace.A84,A71)>0)),goto A65)

Determines whether the workspace value and ideal criteria value share the same sign

A62. IF((AND(INDEX(workspace.A84,A71)<0,INDEX(positive.1,A71<0)), goto A65

Same as A61

A63. =A63 + (INDEX(workspace.A84.A71)+(0-INDEX(positive,1,A71)))^2

Calculates the separation measure. Step 4 of TOPSIS, when criteria values of the workspace & ideal share the same sign

A64. =goto A66

Skips the alternate case calculation (see A65).

A65. =A65 + INDEX(workspace.A84.A71)-INDEX(positive.1.A71))^2

Calculates the separation measure. Step 4 of TOPSIS, when criteria value of the workspace is negative and the ideal criteria value is positive.

A66. =IF((AND(INDEX(workspace.A84.A71)>0,INDEX(negative,1,A71)>0)), goto A70)

Determines whether the workspace value and negative-ideal criteria value share the same sign.

A67. =IF((AND(INDEX(workspace.A84.A71)<0,INDEX(negative.1.A71)<0)), goto A70

Determines whether the workspace value and negative-ideal criteria value share the same sign.

A68. =A68 + ((INDEX(workspace.A84.A71) - INDEX(0-INDEX(negative.1.A71)))^2

Calculates the separation measure. Step 4 of TOPSIS, when criteria values of the workspace and negative-ideal share the same sign

A69. =goto A71

Skips the alternate case calculation(A70).

A70. =A70+(INDEX(workspace.A84.A71)-INDEX(negative.1.A71))^2

Calculate the separation measure. Step 4 of TOPSIS, when value in workspace is positive and the negative-ideal criteria value is negative.

A71. =A71 + 1

Increment counter of inner loop A71

A72. =IF(A72<A4-1.GOTO(A61))

Inner loop terminates when all the columns in row A84 of "workspace" are reached

A73. =SELECT(INDEX(sep,A84,1))

Select row A84-col1 of "sep"

A74. =A63 + A65

Sum all possible separation measures to the ideal

A75. =A68 + A70

Sum all possible separation measures to the negative-ideal

A76. =SQRT(A74)

Take the square root of the result in A74. This is the separation to ideal-solution for each project

A77. =FORMULA(A76)

Write the above result in the selected cell (See A61)

A78. =SELECT(INDEX(sepn,A84,1))

Select row A84-col1 of "sepn"

A79. =SQRT(A75)

Take the square root of the result in A75. This is the separation to negative-ideal solution for each project.

A80. =FORMULA(A79)

Write the above result in the selected cell (See A64)

A81. =SELECT(INDEX(ci,A84,1))

Select row A84-col1 of "ci"

A82. =INDEX(sepn,A84,1)/(INDEX(sepn,A84,1)+INDEX(sep,A84,1))

Calculate relative closeness, i.e., priority index. This is Step 5 of TOPSIS

A83. =FORMULA(A82)

Write the above result to the selected cell (see A81)

A84. =A84+ 1

Increment the outer loop counter A84

A85. =IF(A84<(A3-2),GOTO(A54))

The outer loop terminates when all the rows in "workspace" are reached

A86. =SELECT(ido)

Select "ido", which contains the ID numbers of all the projects

A87. =COPY()

Copy the selected region, i.e., "ido"

A88. =SELECT(id)

Select "id"

A89. =PASTE()

Paste the selected data, i.e., the ID numbers, to "id"

A90. =SELECT(costo)

Select "costco", which contains the cost of all the projects

A91. =COPY()

Copy the selected region

A92. =SELECT(cost)

Select "cost"

A93. =PASTE()

Paste the copied content, i.e., the costs, to "cost"

A94. =SELECT(INDEX(workspace,1,1):INDEX(negative,1,A4-2))

Select the area from the first cell in "workspace" to the last cell in "negative"

A95. =EDIT.DELETE()

Delete the selected area. Notice: steps A94 and A95 clear all the intermediate results on the worksheet

A96. =SELECT(INDEX(sep,1,1):INDEX(sepn,A3-3,1))

Select the area from row1-col1 in "sep" to rowA3-3-col1 in "sepn", which contains the final results of Topsis. We are going to write these results in a new file (see the following a few steps)

A97. =EDIT.DELETE()

Delete the selected area

A98. =INPUT("Enter a new file name (non-existing):",2)

Display a dialog box into which the user can enter information in text, i.e., the filename in which the user wants to store the final results

A99. =FOPEN(A98,3)

Create the file named by the user in A98, with read/write access

A100. =FCLOSE(A99)

Close the file specified in A99

A101. =SELECT(INDEX(ci,1,1):INDEX(cost,A3-3,1))

Select the area from row1-col1 in "ci" to rowA3-3-col1 in "cost"

A102. =SORT(1,,2)

Sort priority indices by rows in descending order. This is Step 6 of TOPSIS

A103. =CUT()

Cut the selected area, i.e., the sorted results

A104. =OPEN(A98)

Open the file created in step A98 as a window

A105. =SELECT("r[1]c")

Select the first row and column "r[1]c"

A106. =PASTE()

Paste the cut content (i.e., the sorted results) in the new file

A107. =SET.NAME("b_range",SELECTION())

Give the selected area a name as "b_range"

A108. =ROWS(b_range)

Return the number of rows in "b_range"

A109. =COLUMNS(b_range)

Return the number of columns in "b_range"

A110. =SELECT("r[-1]c")

Select (an inserted) row above the sorted results in the new file, "r[-1]c"

A111. =FORMULA("Priority Index")

Write the heading "Priority Index" in the first above selected cell

A112. =SELECT("rc[1]")

Select the first cell in the next column over (to the right), "rc[1]"

A113. =FORMULA("Rank Order")

Write the heading "Rank Order" in the above selected cell

A114. =SELECT("rc[1]")

Select the first cell in the next column over (to the right), "rc[1]"

A115. =FORMULA("Project cost")

Write the heading "Project cost" in the above selected cell

A116. =SELECT("rc[1]")

Select the first cell in the next column over, "rc[1]"

A117. =FORMULA("Total Budget")

Write the heading "Total Budget" in the above selected cell

A118. =SELECT("r[2]c")

Select the cell two rows beneath the previous cell (in the fourth column), "r[2]c"

A119. =FORMULA("Remainings")

Write the heading "Remainings" in the above selected cell

A120. =SELECT("r[-2]c[1]")

Select two rows above and the next cell over (top row, fifth column), "r[-2]c[1]"

A121. =FORMULA("Funded Proj's")

Write the heading "Funded Proj's" in the above selected cell

A122. =SELECT("r[1]c[-1]")

Select the cell one row beneath and one column to the left of the previous (second row, fourth column). "r[1]c[-1]"

A123. =INPUT("Enter the total budget (unit should be consistent with the raw data!)",1)

Display a dialog box for user to enter information as text; i.e., the total available budget

A124. =FORMULA(A123)

Write the value A123 to the above selected cell (under "Total Budget") in new file

A125. =IF(A123>=INDEX(b_range,1,3),GOTO(A128))

Determine whether the top priority project is funded under the input budget scenario. Begins the outer loop if there is enough funding.

A126. =ALERT("No projects can be funded under this ranking order! Please check your total budget.")

Display a dialog box notifying user that the total budget entered will not cover the project cost of the top ranked item

A127. =RETURN()

Stop the macro

A128. =SET.VALUE(A131,0)

Start inner loop. Initializes the counter at cell A131 to zero.

A129. =SET.VALUE(A130,0)

Start outer loop. Initializes the counter at cell A130 to zero

A130. =A130+1

Increment the outer loop counter A130

A131. =A131+INDEX(b_range,A130,3)

Calculate the accumulated project cost in descending priority order

A132. =IF(A131>A123,GOTO(A139))

Determine if accumulated project cost exceeds the total budget input

A133. =IF(A130=A108,ALERT("all projects can be funded!"),GOTO(A138))

Determine if the project is from the last row in "b_range"

A134. =SELECT("r[2]c")

Select cell two rows beneath previous cell in new file under "Remainings" (fourth row, fourth column), "r[2]c"

A135. =A123-SUM(INDEX(b_range,1,3):INDEX(b_range,A108,3))

Calculate the remaining budget if any

A136. =FORMULA(A135)

Write the value of A135 to the above selected cell

A137. =RETURN()

Increment the inner loop

A138. =GOTO(A130)

End of outer loop

A139. =A123-(A131-INDEX(b_range,A130,3))

Calculate remaining budget; i.e., subtracts partially funded project from accumulated project costs of A131

A140. =SELECT("r[2]c")

Select cell two rows beneath previous cell in new file under heading "Remainings" (fourth row, fourth column), "r[2]c"

A141. =FORMULA(A139)

Write the value A139 to above selected cell

A142. =SELECT(INDEX(b_range,1,2):INDEX(b_range,A130-1,2))

Select the cells of row1-col2 in "b_range" through row A130-1 (outer loop counter)-col2

A143. =COPY()

Copy selected cells

A144. =SELECT("rc[3]")

Select cell three columns over previous selection, "rc[3]": i.e., under heading "Funded Proj's"

A145. =PASTE()

Paste copied cells from above in selected cells; i.e., paste names of projects funded by total budget input under the heading "Funded Proj's"

A146. =ALERT("This is the end!",3)

Display dialog box notifying user that the algorithm is finished

A147. =RETURN()

Stop the macro.

APPENDIX D. SUMMARY OF DELPHI ANALYSIS FOR WEIGHT SETTING

SUMMARY OF DELPHI ANALYSIS FOR WEIGHT SETTING

September, 1993
University of Washington Campus

Introductory Discussion:

- Presentation of ranking methodology and categories of evaluation criteria.
- Presentation of the Delphi Analysis framework and session proceedings.

ROUND 1 RESULTS:

	NPV	CMTY	ENV	MODE	L/U
Mean	51	17	12	11	9
Standard Deviation	18	11	7	3	5

Major Discussion Points:

- Concern that Community Support is not adequately represented
- Concern that project costs will eliminate certain high cost projects

ROUND 2 RESULTS:

	NPV	CMTY	ENV	MODE	L/U
Mean	53	17	11	10	9
Std Dev.	11	10	6	4	5

Major Discussion Points:

- That NPV represents a large number of policy goals and is not being given adequate emphasis
- Next round -resolved to give each sub-goal under NPV its own weight and sum total for NPV full weight.

ROUND 3 RESULTS:

	NPV	CMTY	ENV	MODE	L/U
Mean	65	14	8	7	6
Std Dev.	8	7	3	1	1

Major Discussion Points:

- The criteria objectives need to be repackaged to make it explicit that NPV carries a fair number of policy goals with it.
- These results shall be the committee recommendation to full WSTC for adoption.

APPENDIX E. PRIORITIZED MOBILITY PROJECTS - 1995-1997 BIENNIUM

MOBILITY IMPROVEMENT PROGRAM (I1) 95-97 BIENNIUM STATEWIDE RANKING

RURAL

Rank Order	Priority Index	Project	B/C 0.65 1	Cmty Sup. 0.14 [1] 0	Wetlands [2] 0.0267 0	Water Q. 0.0267 0	Noise 0.0266 0	Mode Int. [3] 0.07 [4] 0	L/U 0.06 1	WSDOT Project Cost
1	0.9593	D- 3, SR 101, Chicken Coop Road EB Passing / Truck Climbing Lane	55.54	4	0.5	15	0	10	11	503,109
2	0.6294	D- 3, SR 101, Dawley Rd. to Blyn Hwy., Truck Climbing Lane	34.96	4	1.4	21	5	9	11	1,096,800
3	0.5479	D- 3, SR 101, Gardiner Cemetery Road to MP 277.6	30.36	4	1	10	5	9	10	1,355,750
4	0.4573	D-5, SR 90, Elk Heights Vic WBND TCL	25.23	4	1.5	2	0	9	14	5,270,516
5	0.4114	D- 3, SR 101, Blyn Eastbound Passing Lane	22.69	5	0.5	11	0	10	11	595,400
6	0.3980	D- 5, SR 970, Teanaway River to Virden	21.91	5	0.5	0	0	9	13	1,950,000
7	0.2990	D- 3, SR 5, Maytown I/C to 93rd I/C	15.89	1	0.5	6	0	9	13	6,662,500
8	0.2459	D- 5, SR 90, Highline Canal vicinity to Elk Heights I/C vic.	13.04	4	1.5	2	0	9	14	6,889,155
9	0.1757	D- 5, SR 90, Rygrass Summit to Columbia River Bridges	8.77	4	0.5	1	0	9	9	8,012,319
10	0.1529	D-1, SR 20, Fredonia to SR 5 - Widening	6.87	2	0.5	9.0	49	9	11	35,995,000
11	0.1173	D-5, SR 90, Ryegrass Summit Vic EBND TCL	4.69	4	0.5	1	0	9	9	1,592,464
12	0.1162	D- 6, SR 90, Harvard Road I/C	3.72	2	0	4	2	7	14	14,500,000
13	0.1147	D-5, SR 12, Airport Rd Interchange Modification	3.05	1	0.5	1	16	5	11	797,000
14	0.1082	D- 5, SR 24, Vernita Hill Vicinity	3.49	3	0.5	1	0	9	10	850,000
15	0.1071	D-1, SR 539, Lynden Park & Ride Lot	0.55	0	0.5	1.5	24	5	14	1,271,000
16	0.1032	D- 3, SR 101, Mt. Walker N.B. Passing / Truck Climbing Lane	3.49	4	0.5	10	0	9	10	372,879
17	0.1011	D-1, SR 539, Horton Rd to Laurel Rd (Stage 1) - Widening	3.73	4	2.8	8.5	326	9	14	20,565,000
18	0.1011	D- 3, SR 104, Kingston Traffic Circulation Imp.	3.19	4	0.5	26	15	5	14	6,377,000
19	0.1006	D- 3, SR 101, Blyn Westbound Passing Lane	3.60	5	0.5	11	0	10	11	644,600
20	0.0996	D-1, SR 539, Laurel Rd to Tenmile Rd (Stage 2) - Widening	1.98	2	0.5	10.0	98	9	14	4,516,000
21	0.0990	D- 3, SR 104, SR 19 - West WB Passing / Truck Climbing Lane	3.08	4	0.8	14	0	10	11	912,000
22	0.0964	D- 3, SR 109, NB Truck Climbing Lane, MP 4.5	2.76	4	0.5	10	0	8	11	1,868,900

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Figure E-1. Rural Prioritization

Pgm Mgn't 11/4/94

MOBILITY IMPROVEMENT PROGRAM (I1) 95-97 BIENNIUM STATEWIDE RANKING

RURAL

Rank Order	Priority Index	Project	B/C 0.65	Cmty Sup. 0.14	Wetlands 0.0267	Water Q. 0.0267	Noise 0.0266	Mode Int. 0.07	L/U 0.06	WSDOT Project Cost
			1	0	0	0	0	0	1	
23	0.0952	D-1, SR 2, Sultan City Limits - TWLTL Lane	1.16	2	0.5	0.5	25	10	6	338,000
24	0.0945	D- 3, SR 109, SB Truck Climbing Lane (EB), MP 4.5	2.54	4	0.5	11	0	8	11	1,391,801
25	0.0910	D-2, SR 26, SR 243 I/C TO MP 5.5 VIC	1.35	3	0.5	14	0	10	10	1,516,640
26	0.0907	D- 3, SR 101, Northbound Passing Lane	2.10	4	0.5	15	0	10	11	599,400
27	0.0891	D- 3, SR 3, Belfair Vicinity	2.70	6	0.5	10	0	7	14	1,069,260
28	0.0890	D-1, SR 2, Index vicinity	0.83	3	2.5	27	3	9	14	3,382,000
29	0.0880	D-1, SR 5, Blaine - NB Pace Lane Extension	0.78	3	0.5	0.5	25	10	5	2,366,000
30	0.0877	D- 6, SR 195, Plaza to Spangle	0.36	3	1.3	0	5	8	8	17,450,000
31	0.0876	D- 5, SR 12, Waitsburg By-pass	1.20	3	13.5	24	6	8	13	5,401,792
32	0.0875	D- 3, SR 101, Southbound Passing Lane	1.61	4	0.5	15	0	10	11	623,540
33	0.0865	D- 6, SR 904, Cheney to SR 90	1.27	3	9 8	19	67	8	9	9,915,350
34	0.0846	D- 6, SR 195, Rosalia to Plaza	0.27	3	7.9	25	4	8	8	24,307,500
35	0.0845	D- 2, SR 215, Omak vicinity	0.33	4	0	1	0	6	13	1,150,000
36	0.0844	D- 3, SR 109, SB Passing Lane, MP 14.5 to 15.0	0.89	4	0.5	9	0	9	11	290,900
37	0.0843	D- 3, SR 109, NB Passing Lane, MP 14.5 to 15.0	0.87	4	0.5	9	0	9	11	299,800
38	0.0842	D- 5, SR 12, Old Naches Road Interchange	0.94	4	2.5	5.5	0	9	11	12,920,000
39	0.0841	D- 3, SR 109, SB Passing Lane, MP 14.0 to 15.0	0.90	4	0.6	14	0	9	11	587,900
40	0.0839	D- 3, SR 101, Shore Road to Joslin Road	3.90	8	24	16	408	9	14	17,331,550
41	0.0834	D- 3, SR 109, NB Passing Lane, MP14.0 to 15.0	0.71	4	0.6	14	0	9	11	765,110
42	0.0824	D-1, SR 2, SR 2 to SR 522 Monroe Bypass	1.11	4	2.2	12.0	116	7	11	28,534,000
43	0.0821	D- 6, SR 395, Hamilton Road to Montgomery Road	1.10	4	1.5	25	71	8	8	12,078,200
44	0.0816	D- 5, SR 12, SR 124 Interchange	0.21	4	13.25	8	0	3	14	8,000,000
45	0.0814	D- 4, SR 6, Pluvius Vicinity Realignment	0.30	4	0.625	7	0	7	0	1,176,000
46	0.0798	D- 4, SR 6, Rock Creek Bridge Replacement & Realignment	0.12	4	2.35	23	0	7	0	2,067,000
47	0.0789	D- 4, SR 4, Svensons Curve Realignment	0.34	4	4.625	24	12	10	0	1,561,000
48	0.0782	D- 5, SR 12, SR 124 to Boise Cascade	0.49	4	35	9.5	32	3	14	17,300,000
49	0.0772	D- 4, SR 503, Lewisville Park vicinity Climbing Lanes	1.03	5	2	22	4	10	1	2,879,000
50	0.0771	D- 6, SR 395, MP 172 to Hamilton Road	0.98	5	2.5	24	36	8	8	9,508,800

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Figure E-1. Rural Prioritization (continued)

Pgm Mgn't 11/4/94

MOBILITY IMPROVEMENT PROGRAM (I1) 95-97 BIENNIUM STATEWIDE RANKING

RURAL

Rank Order	Priority Index	Project	B/C 0.65 1	Cmty Sup. 0.14 * 0	Wetlands 0.0267 * 0	Water Q. 0.0267 * 0	Noise 0.0266 * 0	Mode Int. 0.07 * 0	L/U 0.06 * 1	WSDOT Project Cost
51	0.0765	D-1, SR 5, SR 5, 9, 539 and 543 SC&DI	1.25	6	0.5	0.5	0	8	5	2,386,000
52	0.0763	D-1, SR 530, SR 5 to Old SR 99 Wye Connection - Widening	0.43	5	1.0	11.0	7	10	5	1,062,000
53	0.0759	D- 5, SR 12, SR 410 to Naches	0.38	4	43.5	15.5	15	8	13	16,208,740
54	0.0750	D-1, SR 539, Tenmile Rd to Int'l Boundary: Fishtrap Creek to W Main St (Stage 1) - Widening	1.87	5	2.8	12.5	537	9	14	18,053,000
55	0.0747	D- 6, SR 270, Johnson Rd. to Idaho State Line	0.71	5	10.6	24	10	7	9	12,502,525
56	0.0747	D- 3, SR 12, Passing lanes MP 32.00 to MP 33.83	0.39	6	0.5	15	0	10	14	1,047,864
57	0.0742	D- 5, SR 22, I-82 to SR 97	0.26	5	6.5	30	96	8	14	34,000,000
58	0.0737	D- 4, SR 101, Smith Creek Road vicinity Climbing Lane	0.51	5	8.875	24	0	9	5	5,655,000
59	0.0732	D- 3, SR 101, Carlsborg/Hooker Roads I/C	1.73	10	0.5	15	0	7	14	6,049,480
60	0.0721	D1, SR 522, Snohomish Riv Br to SR 2 (Stage 3) - Widening	0.23	5	0.8	13.0	227	10	10	38,498,000
61	0.0693	D- 3, SR 101, SR 101/SR 107 I/C	0.27	7	0.5	14	0	8	9	777,230
62	0.0660	D- 4, SR 97, Brooks Park to Summit Climbing Lane	0.52	8	0.5	8.5	3.5	9	0	3,789,000
63	0.0610	D- 5, SR 90, Hyak to Stampede Road I/C	0.76	7	30.25	13.5	10	9	4	26,838,000
64	0.0526	D-1, SR 96, Seattle Hill Rd to SR 9 - Widening & Realignment	0.25	6	4.0	11.5	1318	8	11	15,960,000

Figure E-1. Rural Prioritization (continued)

MOBILITY IMPROVEMENT PROGRAM (I1) 95-97 BIENNIUM STATEWIDE RANKING

URBAN

Rank Order	Priority Index	Project	B/C 0.65 1	Cmty Sup. 0.14 0	Wetlands 0.0267 0	Water Q. 0.0267 0	Noise 0.0266 0	Mode Int. 0.07 0	L/U 0.06 1	WSDOT Project Cost (dollars)
		EXCEPTIONS:								
1	-	D-1, SR 99, Vic. 60th Ave to SR 525 (Stage 2) - Widening	291.79	1	0.6	10.5	388	4	14	1,014,000
2	-	D-1, SR 99, King/Snohomish CL to Vic. 60th Ave (Stage 1) - Widening	232.58	1	0.5	10.5	304	4	14	1,217,000
3	-	D- 5, SR 240, Edison Street I/C	86.32	1	0.5	12	28	4	14	3,253,200
4	0.9437	D- 3, SR 161, SR 161 / SR 167 Eastbound Ramp	66.50	5	0.5	12	0	8	14	505,336
5	0.9336	D- 3, SR 510, Martin Way to Pacific Avenue SE	63.83	5	0.5	4	102	3	14	7,706,016
6	0.7139	D- 3, SR 16, Gig Harbor I/C	47.32	0	0.5	6	0	8	14	1,360,000
7	0.6820	D- 3, SR 510, SR 5 to Martin Way	45.46	5	0.5	4	0	6	14	2,801,803
8	0.6536	D- 6, SR 2, SR 2/SR 206/Market St. Intersection	43.40	3	0	2	34	8	8	626,730
9	0.5925	D-1, SR 99, 35th Ave. W (Lake Rd.) to SR 525 - NB Right Turn Lane	39.56	7	0.5	0.5	20	10	14	168,000
10	0.4634	D- 4, SR 501, Mill Plain Extension	30.55	4	0.5	1.5	180	6	11	500,000
11	0.3958	D- 3, SR 305, SR 3 to Bond Road	25.86	3	4.5	15	6	7	14	3,441,469
12	0.3694	D- 3, SR 161, 204th St. E to 176 St E	24.06	3	0.5	8	112	9	11	2,948,500
13	0.3634	D- 3, SR 16, SR 5 to Wollochet TSM	23.59	3	0.5	5	0	6	14	4,052,000
14	0.3048	D-1, SR 99, Airport Rd: I/S HOV Priority	19.19	0	4.5	7.0	103	10	14	200,000
15	0.2955	D-6, SR 90, University Rd I/C	18.87	3	0	2	61	6	9	13,000,000
16	0.2840	D- 3, SR 161, 36th to Jovita	18.36	6	0.5	13	141	9	14	4,695,530
17	0.2536	D- 3, SR 101, Mottman Road I/C	15.53	1	0.5	6	0	5	14	3,540,589
18	0.2525	D-6, SR 90, Pines Rd I/C Modification	15.66	2	0	2	0	9	8	460,000
19	0.2460	D- 3, SR 410, Linden Drive I/C	15.20	2	0.5	21	13.5	8	14	4,157,504
20	0.2372	D- 3, SR 510, SR 5 O-xing	14.67	3	0.5	4	0	6	11	9,104,160
21	0.2248	D- 3, SR 410, 214th Avenue E to 234th	13.30	0	0.5	13	213	10	11	3,608,693
22	0.2161	D-1, SR 527, SR 522/Main St Intersection Improvements	12.99	2	0.5	10.0	36	9	11	1,056,000
23	0.1990	D- 5, SR 224, SR 240 Interchange	11.90	4	0.5	1	3	3	14	10,180,799
24	0.1967	D- 3, SR 3, SR 3/SR 303 I/C (Waaga Way)	11.23	1	0.5	12	0	10	14	4,215,120

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Figure E-2. Urban Prioritization

Pgm Mgn't 11/4/94

MOBILITY IMPROVEMENT PROGRAM (I1) 95-97 BIENNIUM STATEWIDE RANKING

URBAN

Rank Order	Priority Index	Project	B/C 0.65 1	Cnty Sup. 0.14 0	Wetlands 0.0267 0	Water Q. 0.0267 0	Noise 0.0266 0	Mode Int. 0.07 0	L/U 0.06 1	WSDOT Project Cost (dollars)
25	0.1866	D-1, SR 522, Lake City Way Multi-Modal Project - SR 5 to SR 405 - HOV Priority	11.53	7	0.5	15.0	287	5	9	6,409,000
26	0.1833	D-1, SR 5, Northbound Downtown Rechannelization	11.13	7	0.5	0.0	0	8	9	2,090,000
27	0.1538	D- 6, SR 2, North Spokane/Division St. -Stage 2	8.43	4	0	2	123	4	14	2,925,000
28	0.1502	D-1, SR 9, SR 522 to Clearview (Stage 2): 228th to SR 524/212th-Widening	7.70	2	1.3	11.5	38	10	11	4,792,000
29	0.1481	D-1, SR 527, 164th St SE to 132nd St SE - Widening	7.99	3	0.7	17.0	345	5	11	14,573,000
30	0.1471	D-1, SR 524, 24th to SR 527 - Widening	8.72	5	10.5	22.0	704	9	11	6,839,000
31	0.1452	D-1, SR 900, Duvall Ave SE to SR 90 (Stage 1): Tibbets Creek to SR 90 - Widening	9.34	5	95.0	27.0	680	6	11	5,467,000
32	0.1405	D-1, SR 161, Jovita Blvd to SR 18 (Stage 2): Milton Way to S 360th/Milton Rd S-Widening	7.94	5	6.5	17.0	290	8	11	10,232,000
33	0.1362	D- 5, SR 82, I-82 / Yakima Ave.	5.21	0	2	6	19	5	14	2,800,000
34	0.1330	D- 3, SR 161, 234th to 204th	7.19	6	0.5	14	63	9	11	7,565,730
35	0.1309	D-1, SR 542, Orleans to Britton (Stage 1): Orleans St to Hannegan Rd - Widening	5.47	1	2.0	9.5	128	8	11	4,210,000
36	0.1308	D-1, SR 5, Boeing Access Rd I/C - Flyover Structure	5.19	1	0.5	6.0	0	8	14	3,260,000
37	0.1254	D- 3, SR 410, 234th to Hinkleman Ext. Road	5.95	3	2	13	213	10	11	5,800,941
38	0.1224	D1, SR 522, SR 9 to Paradise Lk Rd (Stage 1) - New I/C & Widening	6.31	6	2.5	8.0	62	10	10	29,488,000
39	0.1178	D- 5, SR 240, Stevens Drive to SR 182	4.58	3	0.5	0	0	4	14	15,800,000
40	0.1176	D- 6, SR 90, Sprague Ave. to Argonne Rd. -Stage 2 (Broadway Ave to Argonne Rd)	4.96	3	0	7	162	9	14	15,138,675
41	0.1167	D-1, SR 9, SR 522 to Clearview (Stage 1B): SR 522 to 228th-Widening	4.26	2	0.5	11.0	17	10	11	8,077,000
42	0.1149	D- 6, SR 90, Sprague Ave. to Argonne Rd. -Stage 1 (I/C)	4.58	3	0	7	102	9	14	37,765,775

Figure E-2. Urban Prioritization (continued)

MOBILITY IMPROVEMENT PROGRAM (I1) 95-97 BIENNIUM STATEWIDE RANKING

URBAN

Rank Order	Priority Index	Project	B/C 0.65 1	Cmty Sup. 0.14 0	Wetlands 0.0267 0	Water Q. 0.0267 0	Noise 0.0266 0	Mode Int. 0.07 0	L/U 0.06 1	WSDOT Project Cost (dollars)
43	0.1115	D-1, SR 525, SR 99 to SR 526 - Widening & HOV Lanes	3.62	1	4.2	17.0	474	10	11	17,998,000
44	0.1104	D-1, SR 520, NE 40th St I/C & C-D Lanes	0.48	0	0.5	0.0	1	8	14	13,281,000
45	0.1088	D- 3, SR 3, SR 3/SR 305 Interchange - Stage 2	0.21	0	0.5	6	0	9	11	1,248,000
46	0.1049	D- 5, SR 395, Lewis / Sylvester Street I/C	0.31	1	0	4	0	4	14	5,860,000
47	0.1040	D-1, SR 5, 196th St SW (SR 524) I/C	3.24	4	0.5	3.5	46	1	14	17,589,000
48	0.1039	D-1, SR 20, Avon Ave to SR 9 - Channelization & Access Control	2.54	2	1.3	5.0	192	6	13	1,399,000
49	0.1017	D- 4, SR 5, Burnt Bridge through 78th Street	3.55	4	0.5	14	135	6	14	45,813,311
50	0.1009	D-1, SR 9, SR 522 to Clearview (Stage 3): SR 524/212th to 176th-Widening	2.17	2	0.5	12.5	153	10	11	13,578,000
51	0.1007	D- 6, SR 2, North Spokane/Division St. -Stage 3	3.18	4	0	2	123	5	14	8,046,000
52	0.0998	D- 4, SR 205, 4th Plain Road Southbound on-ramp	1.41	2	0.5	1	13	9	6	1,435,000
53	0.0995	D-1, SR 5, SR 526 to Marysville - HOV Lanes	2.72	4	0.5	1.0	14	4	14	130,130,000
54	0.0993	D- 3, SR 20, Port Townsend Vicinity Truck Climbing Lane	3.53	5	0.5	11	0	7	11	864,529
55	0.0985	D- 3, SR 105, Southbound Truck Climbing Lane	2.89	4	0.5	10	0	9	14	383,936
56	0.0978	D- 3, SR 20, Port Townsend TWLT Lane	2.78	4	0.5	1	0	9	10	362,265
57	0.0978	D-1, SR 20 SPUR, Commercial Ave./ 12th to San Juan / Victoria Ferry Terminal - Widening	0.29	2	0.5	2.5	0	8	13	2,106,000
58	0.0975	D- 3, SR 410, Hinkleman Ext. Road to Park Avenue	2.63	3	0.6	13	213	9	11	3,478,555
59	0.0974	D-1, SR 542, Orleans to Britton (Stage 2): Hannegan Rd to Britton Rd	0.63	1	5.0	9.5	430	8	11	12,209,000
60	0.0967	D- 2, SR 17, Pioneer Way to Stratford Road	0.70	2	1.6	24	52	6	13	4,850,000
61	0.0966	D-1, SR 5, Marysville P&R Lot	1.62	3	1.0	10.0	0	4	11	6,503,000
62	0.0965	D- 5, SR 24, SR 82 to Keys Road, MP 0.0-0.98	2.63	4	0.5	14.5	21	5	11	10,967,191
63	0.0964	D- 4, SR 5, Salmon Creek to SR 205	2.37	4	0.5	16	32	3	14	21,541,000
64	0.0952	D-1, SR 527, 132nd St SE to 112th St SE - Widening	2.53	3	1.4	11.5	387	7	11	13,295,000

APDX_URB.XLS

Figure E-2. Urban Prioritization (continued)

Pgm Mgn't 11/4/94

MOBILITY IMPROVEMENT PROGRAM (I1) 95-97 BIENNIUM STATEWIDE RANKING

URBAN

Rank Order	Priority Index	Project	B/C 0.65 1	Cmty Sup. 0.14 0	Wetlands 0.0267 0	Water Q. 0.0267 0	Noise 0.0266 0	Mode Int. 0.07 0	L/U 0.06 1	WSDOT Project Cost (dollars)
65	0.0944	D- 5, SR 240, SR 182 to Columbia Center I/C	2.73	4	10.5	15.5	41	5	14	21,000,000
66	0.0939	D- 3, SR 105, Northbound Truck Climbing Lane	2.13	4	0.5	10	0	9	14	455,750
67	0.0938	D-1, SR 9, Lake Stevens Park & Ride Lot	0.73	2	11.5	5.5	90	7	11	5,750,000
68	0 0931	D- 4, SR 205, 18th Street Interchange	1.98	4	0.5	2.5	95	6	14	17,686,000
69	0.0919	D- 2, SR 20, MP 277.61 to Bigham Flats	0.27	3	0	11	0	8	13	3,988,000
70	0.0919	D- 3, SR 101, Cloquallam Rd. Undercrossing I/C	0.22	3	0.5	11	0	7	13	5,161,800
71	0.0914	D- 3, SR 510, Bingo Hall Vicinity, TWLT Lane	2.23	5	0.5	4	0	9	14	500,300
72	0.0913	D-1, SR 5, NE 175th St to NE 205th St - Auxiliary Lane	3.01	7	0.5	10.0	18	8	14	4,031,000
73	0 0913	D-1, SR 20, Goldie Rd to Ault Field Rd - TWLT Lane & Access Control	0.16	3	0.5	2 0	14	9	9	5,657,000
74	0.0904	D- 3, SR 510, 93rd to SR 507, TWLT Lane	2.87	8	0.5	4	0	10	14	2,345,346
75	0 0897	D- 3, SR 304, Bremerton Ferry Terminal to Vic Gorst	2.19	5	0.5	19	84	5	14	25,309,000
76	0.0895	D-1, SR 5, 41st Street SE to SR 2 - Northbound Auxilary Lane	0.79	4	0.5	0.5	5	8	14	16,035,000
77	0.0891	D- 5, SR 395, Hillsboro Street I/C	0.57	4	0.5	0	0	8	14	9,577,157
78	0.0891	D- 2, SR 2, Easy Street	0.38	4	0	1	0	4	9	3,400,000
79	0.0887	D- 6, SR 290, Mission Ave. to Argonne Rd.	1.18	4	0	8	98	8	14	8,241,551
80	0 0878	D- 5, SR 82/823, Selah Connection	1.02	4	2.2	12.5	47.5	5	10	27,500,000
81	0.0870	D- 4, SR 14, Brady Road Interchange (SE 192nd)	1.07	3	16.25	30	6	9	9	10,899,500
82	0 0868	D-1, SR 18, Weyerhouser Wy to SR 167 Truck Climbing Shld Lane	2.31	6	5.0	5.0	16	10	13	3,574,000
83	0 0866	D1, SR 522, Paradise Lk Rd to Snohomish River (Stage 2) - New I/C & Widening	3.01	5	23.1	7.5	78	10	10	29,155,000
84	0 0866	D-1, SR 509, SR 518 I/C Modification	1.44	5	0.5	5.0	3	9	11	15,085,000
85	0.0854	D- 4, SR 14, SR 14/SR 500 Interchange	0.74	4	3.5	17	3	8	6	8,138,550
86	0.0853	D-1, SR 5, 172nd St I/C Modifications	2.14	7	0.5	0.0	56	8	11	8,606,000
87	0.0851	D-1, SR 202, E Lk Sammamish Pkwy to Sahalee Wy (Stage 1 & 2) - Additional Lanes	3.14	6	3.5	21.0	537	7	11	30,456,000
88	0.0844	D- 4, SR 500, Ward Road to NE 162nd Avenue	1.38	6	0.5	2.5	7	6	11	2,974,390

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Figure E-2. Urban Prioritization (continued)

Pgm Mgn't 11/4/94

MOBILITY IMPROVEMENT PROGRAM (I1) 95-97 BIENNIUM STATEWIDE RANKING

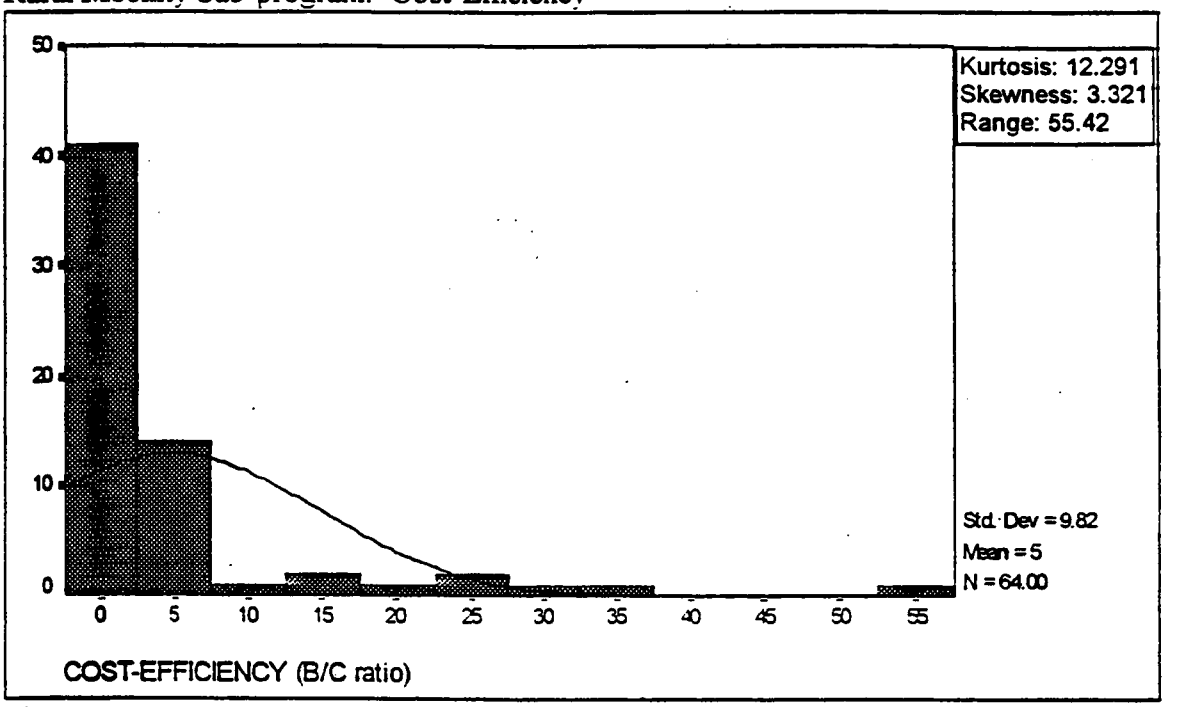
URBAN

Rank Order	Priority Index	Project	B/C 0.65 1	Cmty Sup. 0.14 0	Wetlands 0.0267 0	Water Q. 0.0267 0	Noise 0.0266 0	Mode Int. 0.07 0	L/U 0.06 1	WSDOT Project Cost (dollars)
89	0.0838	D- 6, SR 395, Hastings Road to MP 172, -Stage 2	0.82	5	0	15.5	28	8	13	11,142,272
90	0.0838	D- 3, SR 3, Gorst RR Bridge to SR 304	1.74	5	1.82	29	280	5	14	28,554,240
91	0.0832	D1, SR 90, Sunset I/C Modifications	2.75	5	31.0	21.0	26	10	14	5,876,000
92	0.0831	D- 3, SR 101, Aberdeen/Hoquiam Stage 1	0.22	5	0.5	25	8	6	14	36,220,000
93	0.0827	D-1, SR 5, SR 161 to SR 18 Interchange Modification	0.36	5	0.5	23.0	2	10	14	30,684,000
94	0.0796	D- 4, SR 502, Dollars Corner to Battle Ground	0.70	5	4.63	21	100	9	11	10,553,000
95	0.0789	D- 5, SR 397, Finley Road to East 10th Avenue	0.69	7	0.5	0	10	9	3	3,630,000
96	0 0783	D-1, SR 99, Aurora Br (Geo.Wash Mem Br 99/560) Widening	0 01	7	0.5	15.0	0	7	14	18,722,000
97	0.0753	D-1, SR 169, SR 516 to 196th Ave (Stage 1): 225th SE vic to 220th Pl/Witte Rd - Widening	1.95	8	3.5	25.0	401	7	11	7,914,000
98	0.0746	D- 3, SR 16, Tacoma Narrows Bridge	0.24	8	0.5	26	160	7	14	421,200,000
99	0.0745	D-1, SR 509, South Access Rd Extension	2.16	8	7.3	21.0	1008	3	14	196,030,000
100	0 0710	D- 3, SR 167, SR 5 to SR 161 (Stage 2 construction of new SR 161 alnmt.)	0.24	8	11 5	23	88	9	14	46,186,400
101	0.0709	D- 4, SR 5, Rush Road vicinity to Thurston County Line	2.52	4	121.65	29	33	8	13	121,868,000
102	0.0626	D- 3, SR 167, SR 509 to SR 5 - Stage 1	0.03	8	18.45	27	387	9	14	109,584,000
103	0 0604	D-1, SR 516, Wax Rd to SR 169 (Stages 1 & 2) - Widening	1.19	8	18.9	18.0	824	10	11	19,778,000

Figure E-2. Urban Prioritization (continued)

APPENDIX F. CATEGORY SCORE HISTOGRAMS

Rural Mobility Sub-program: Cost-Efficiency



Rural Mobility Sub-program: Community support

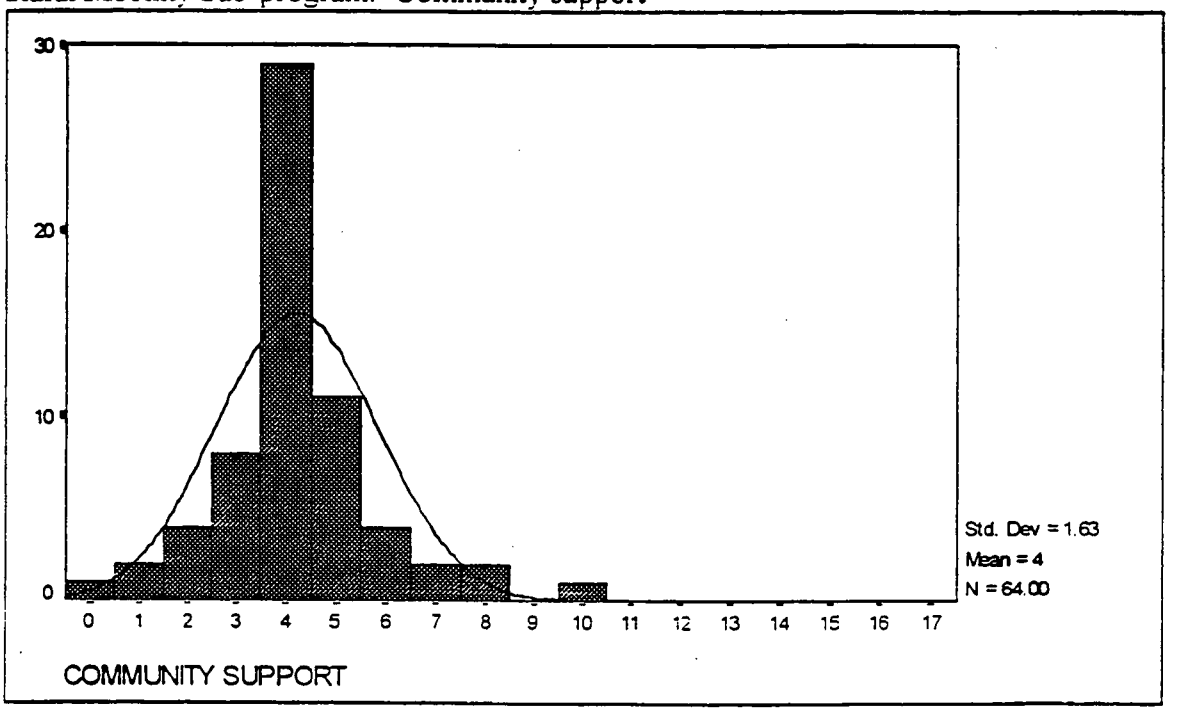
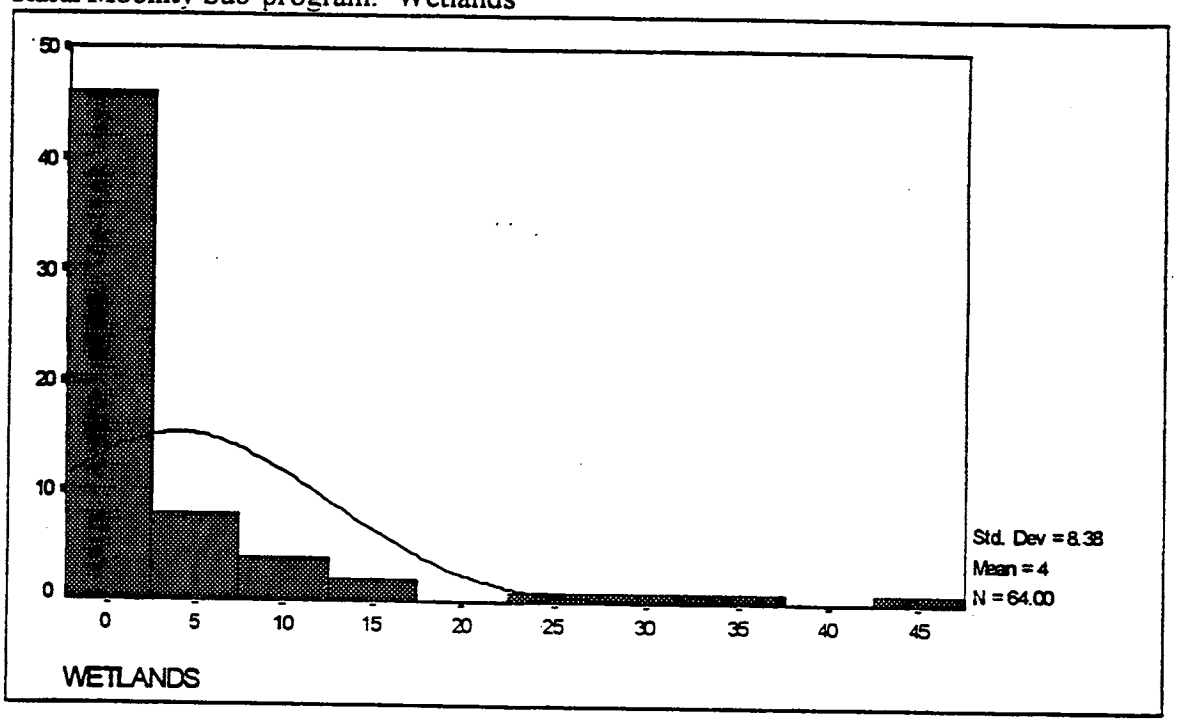


Figure F-1. Rural Mobility Sub-Program Histograms

Rural Mobility Sub-program: Wetlands



Rural Mobility Sub-program: Water quality

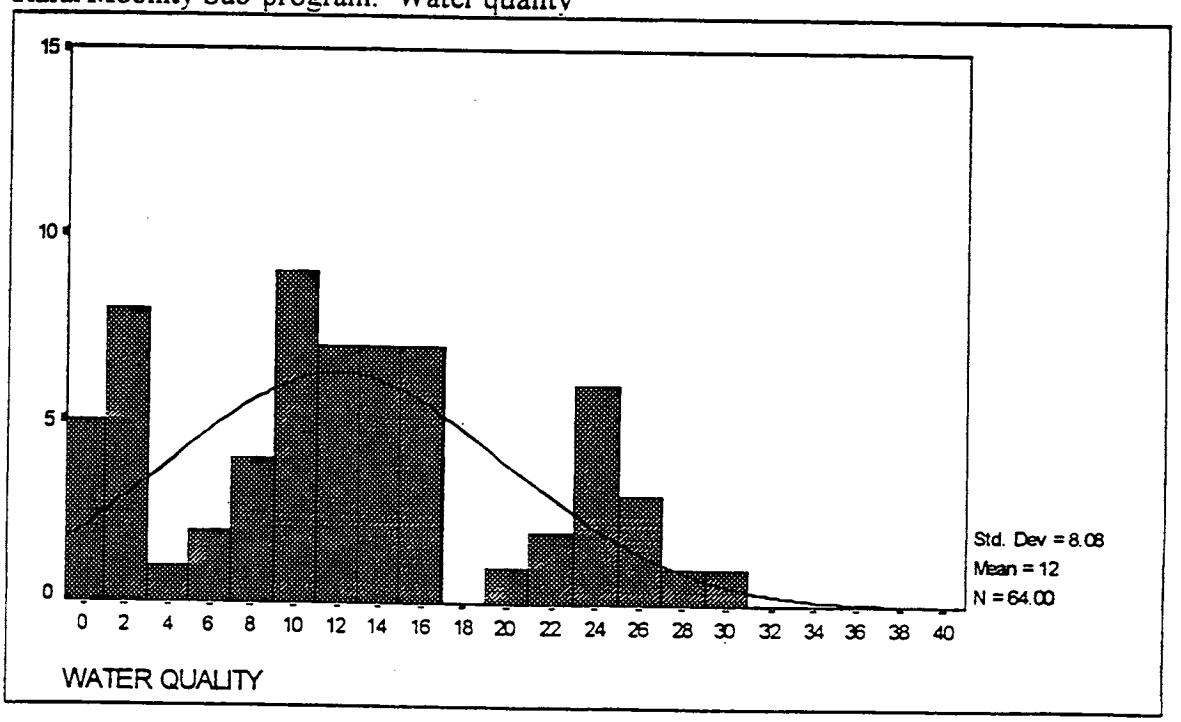
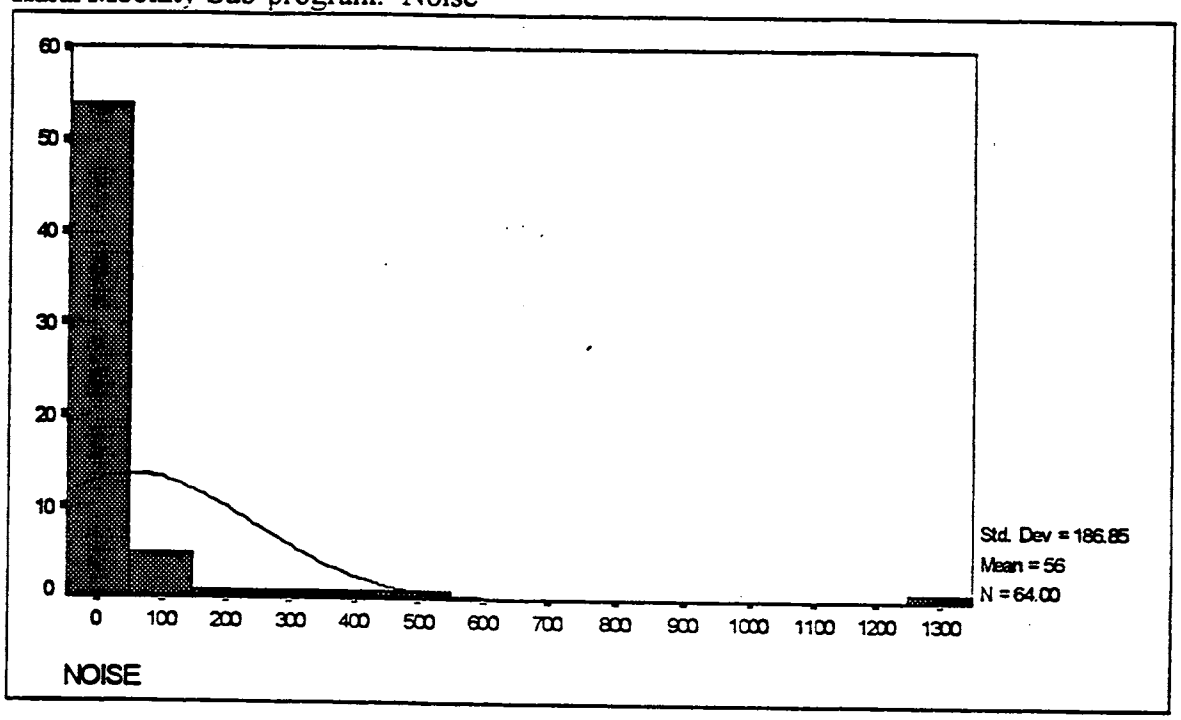


Figure F-1. *Rural Mobility Sub-Program Histograms (continued)*

Rural Mobility Sub-program: Noise



Rural Mobility Sub-program: Noise category - truncated

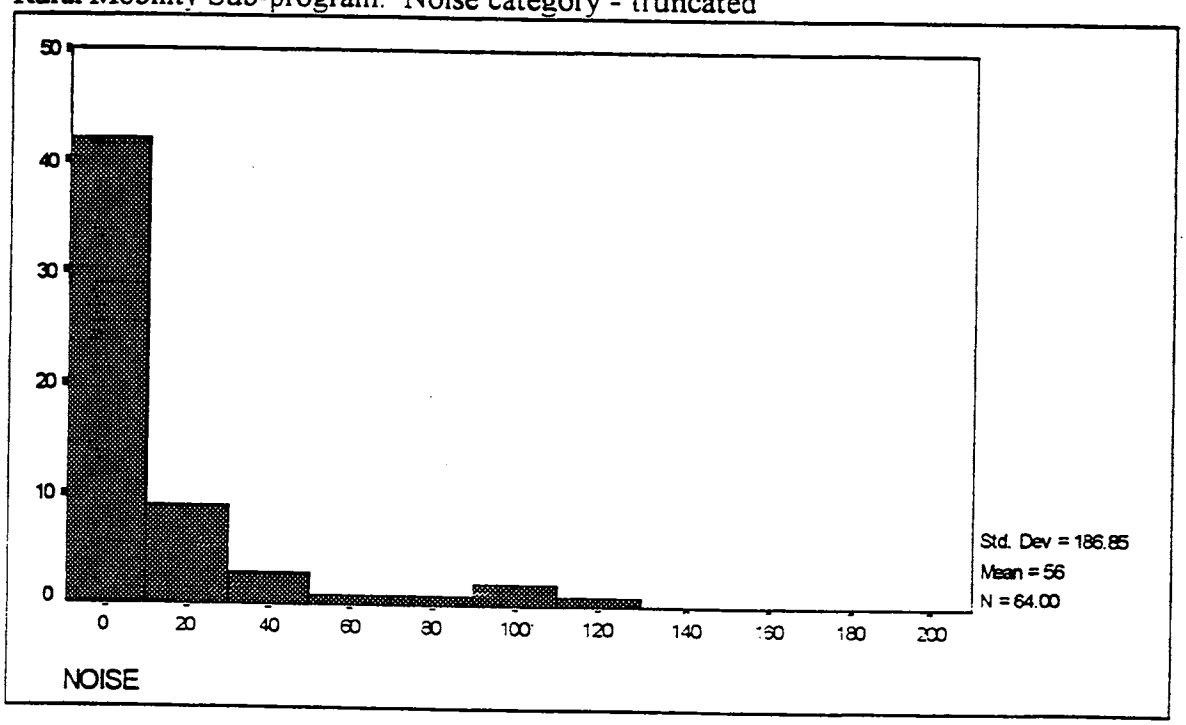
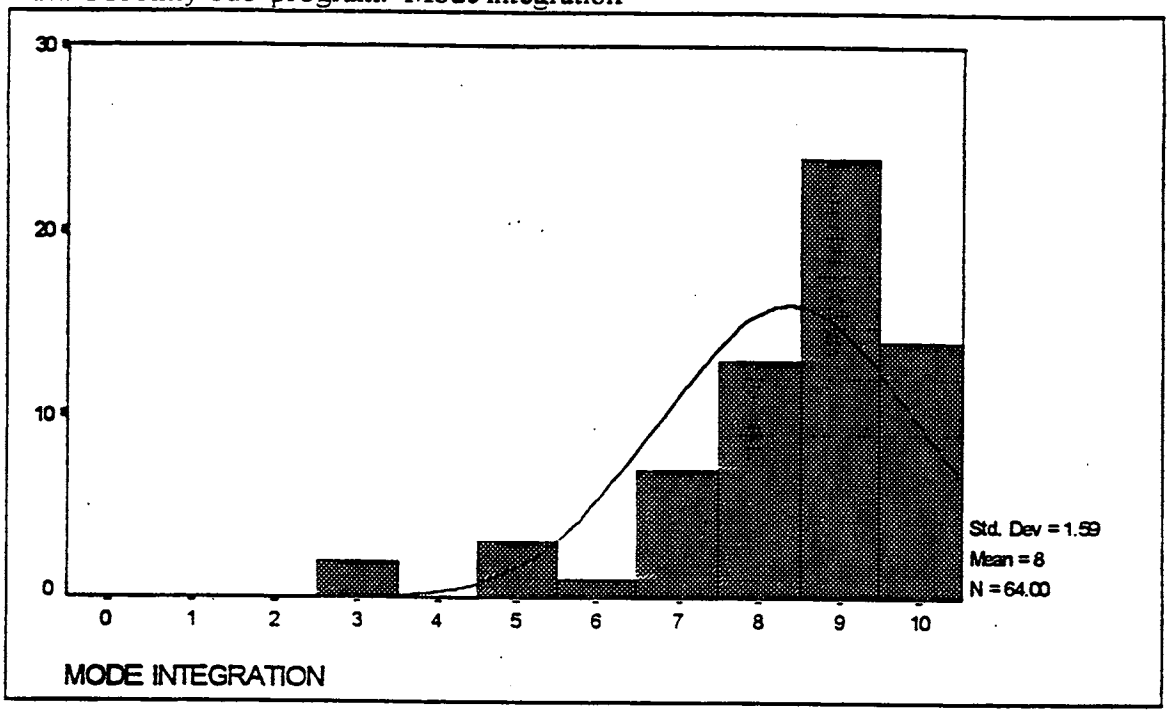


Figure F-1. *Rural Mobility Sub-Program Histograms (continued)*

Rural Mobility Sub-program: Mode integration



Rural Mobility Sub-program: Land use

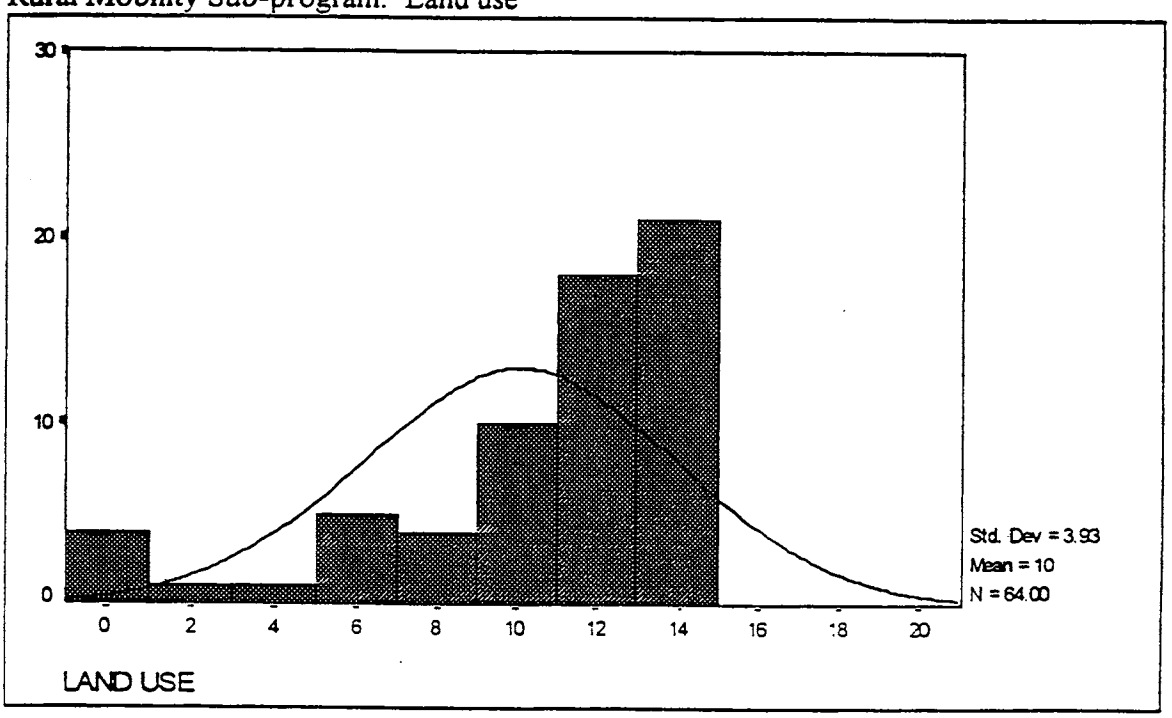
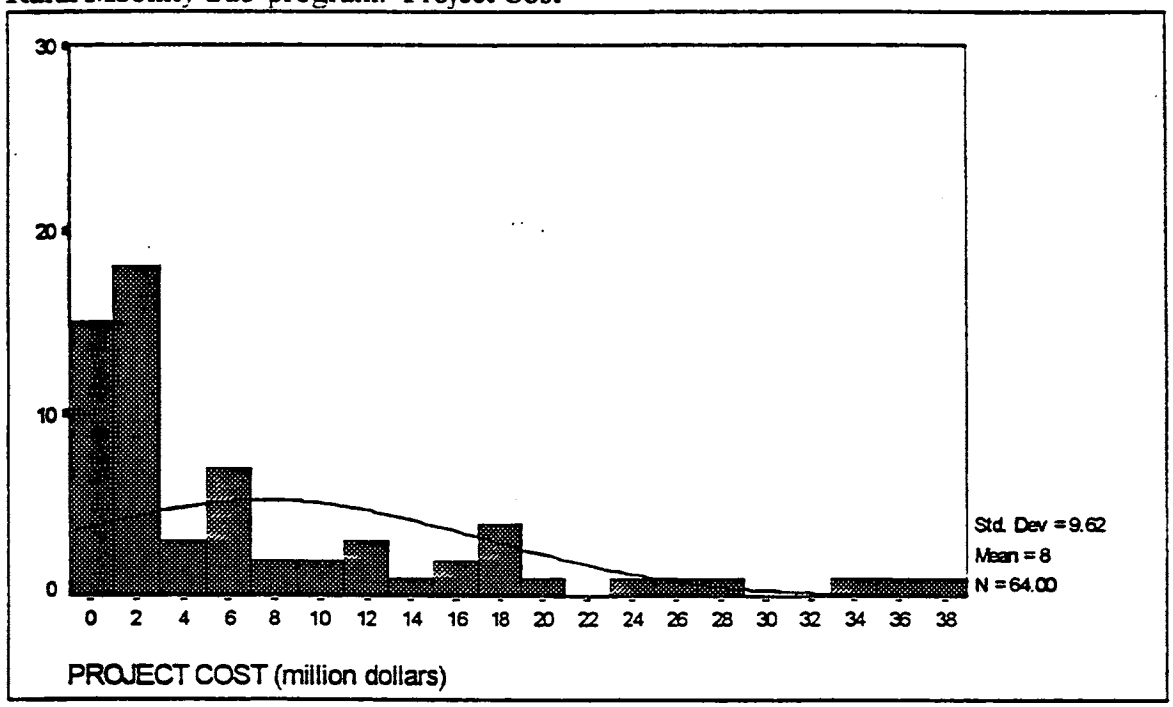


Figure F-1. *Rural Mobility Sub-Program Histograms (continued)*

Rural Mobility Sub-program: Project Cost



Rural Mobility Sub-program: Project Net present value

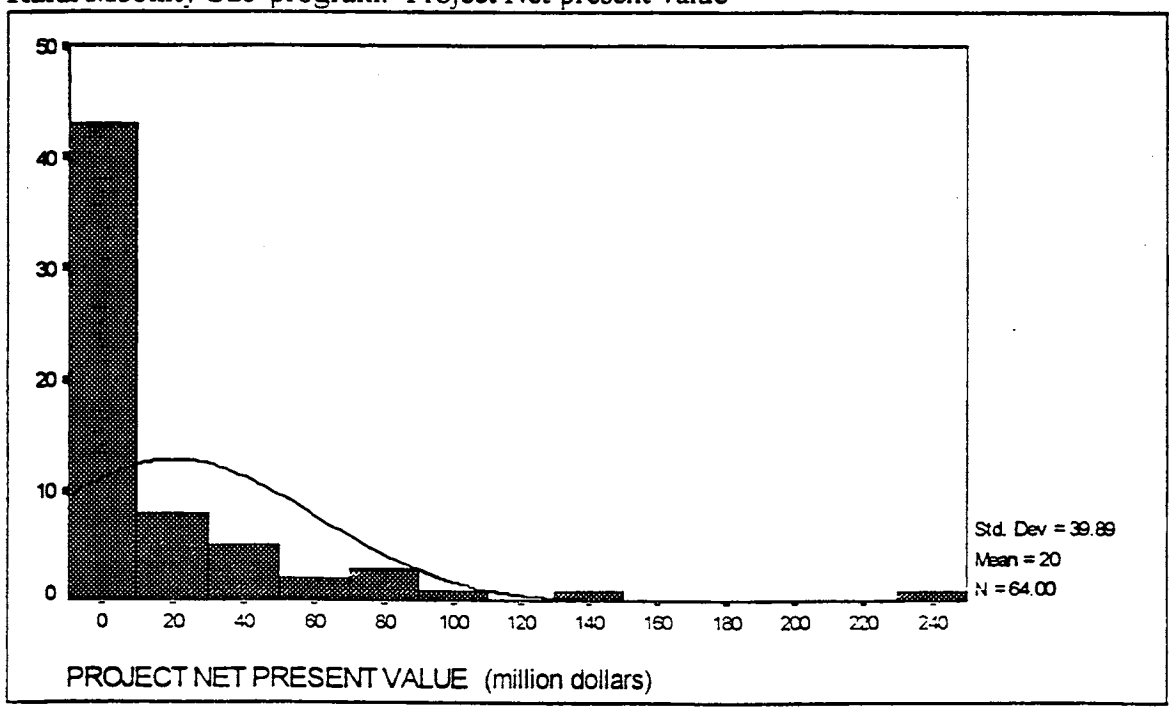
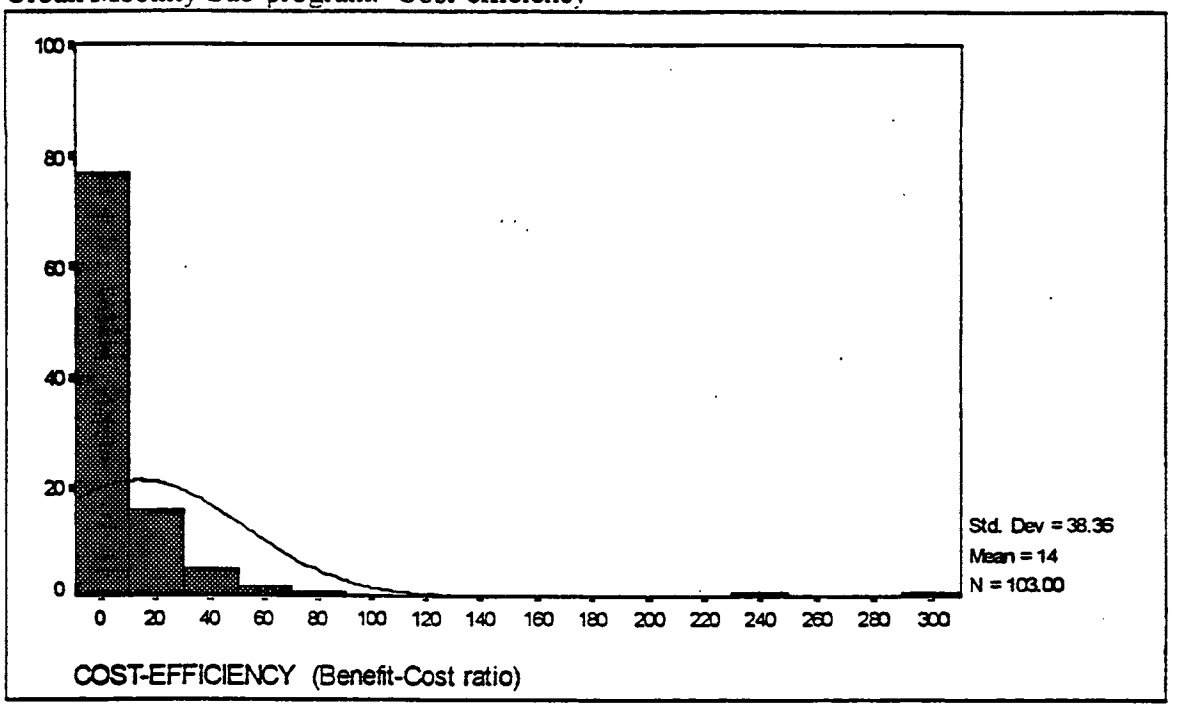


Figure F-1. Rural Mobility Sub-Program Histograms (continued)

Urban Mobility Sub-program: Cost-efficiency



Urban Mobility Sub-program: Cost-efficiency - Truncated

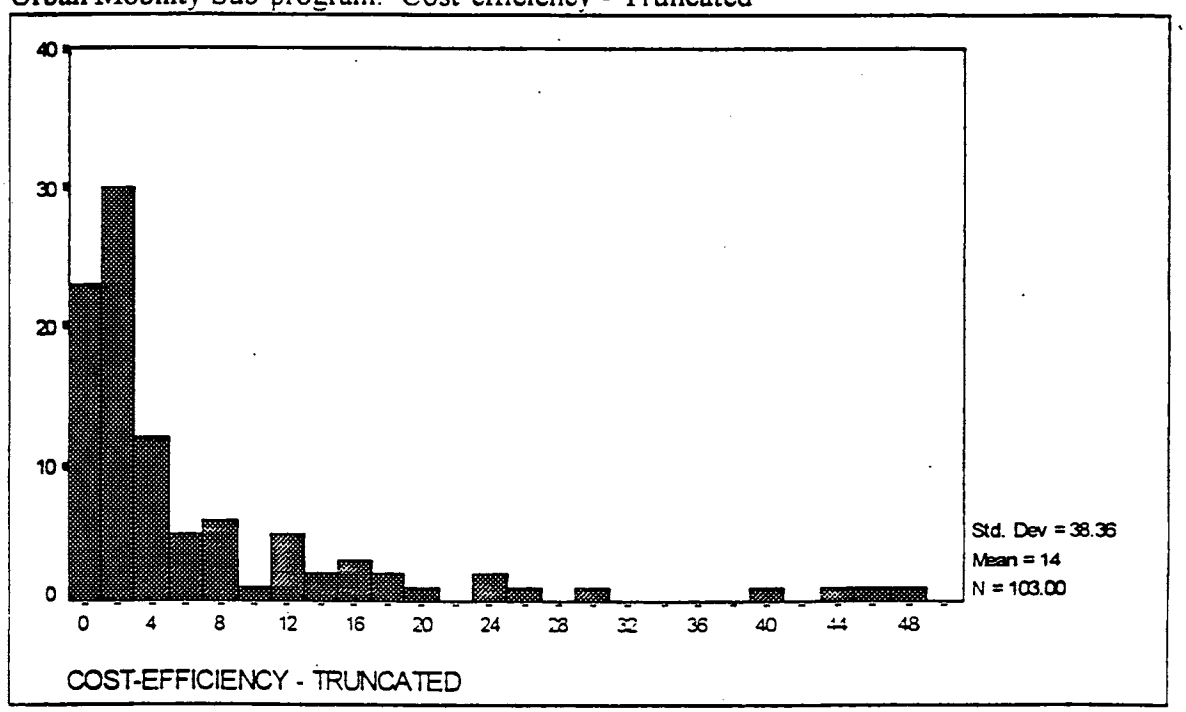
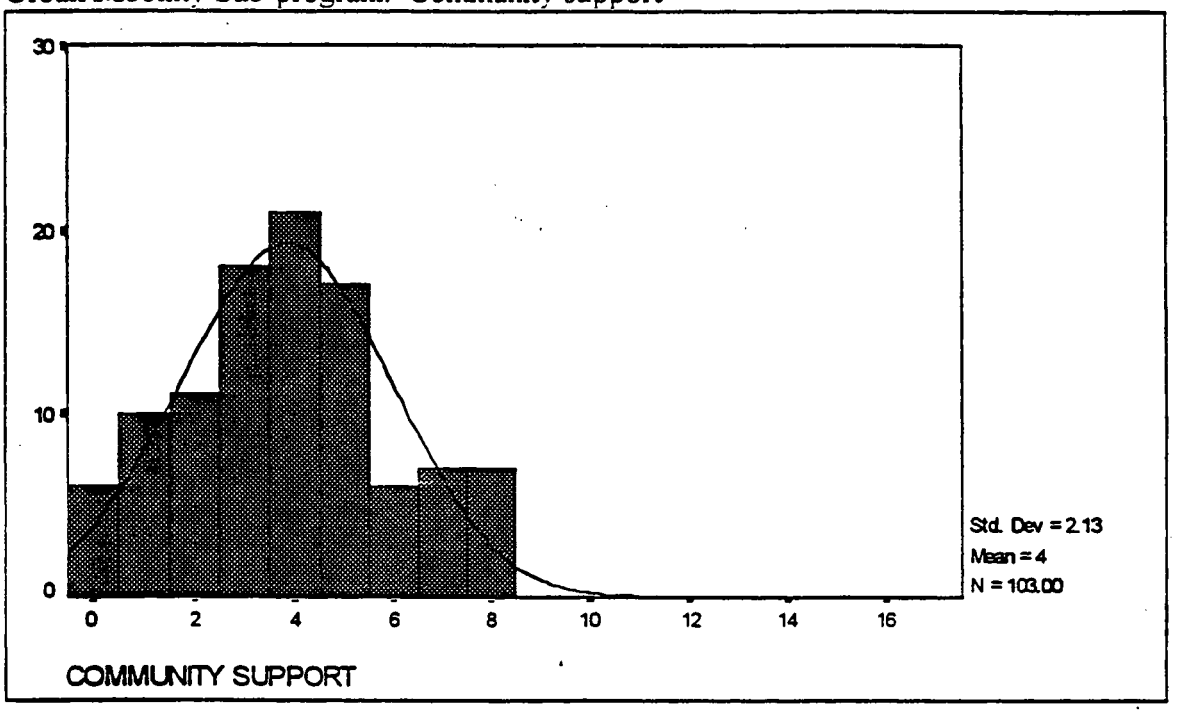


Figure F-2. Urban Mobility Sub-Program Histograms

Urban Mobility Sub-program: Community support



Urban Mobility Sub-program: Wetlands

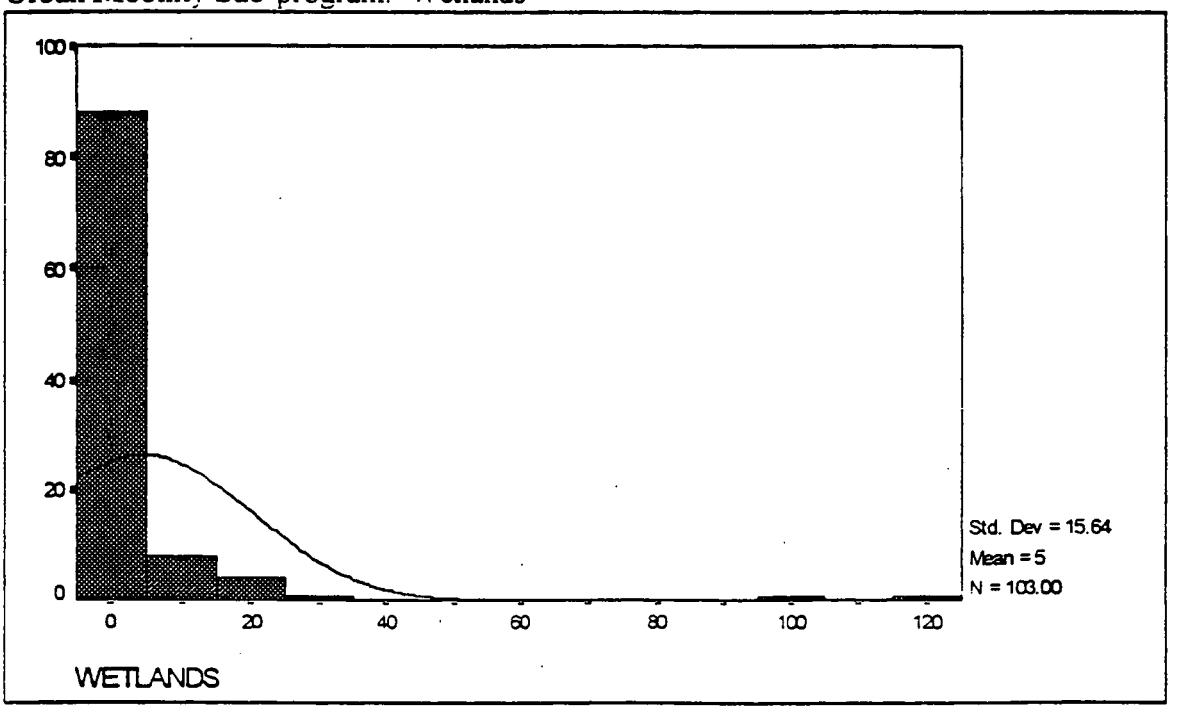
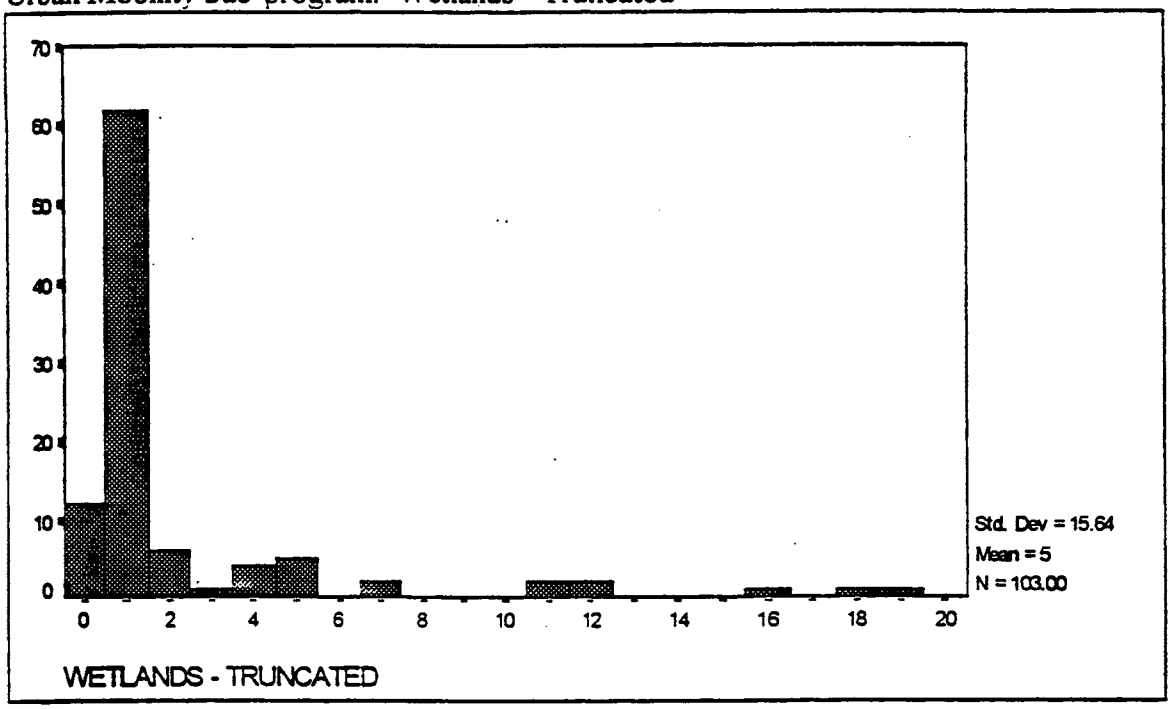


Figure F-2. Urban Mobility Sub-Program Histograms (continued)

Urban Mobility Sub-program: Wetlands - Truncated



Urban Mobility Sub-program: Water quality

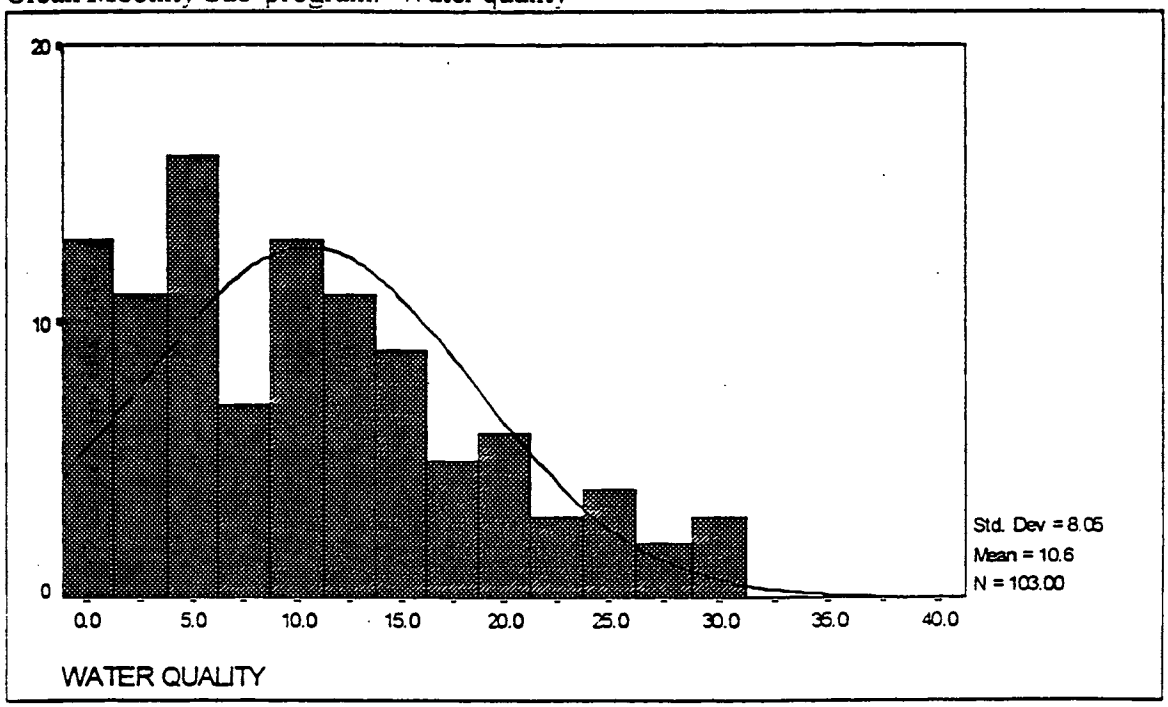
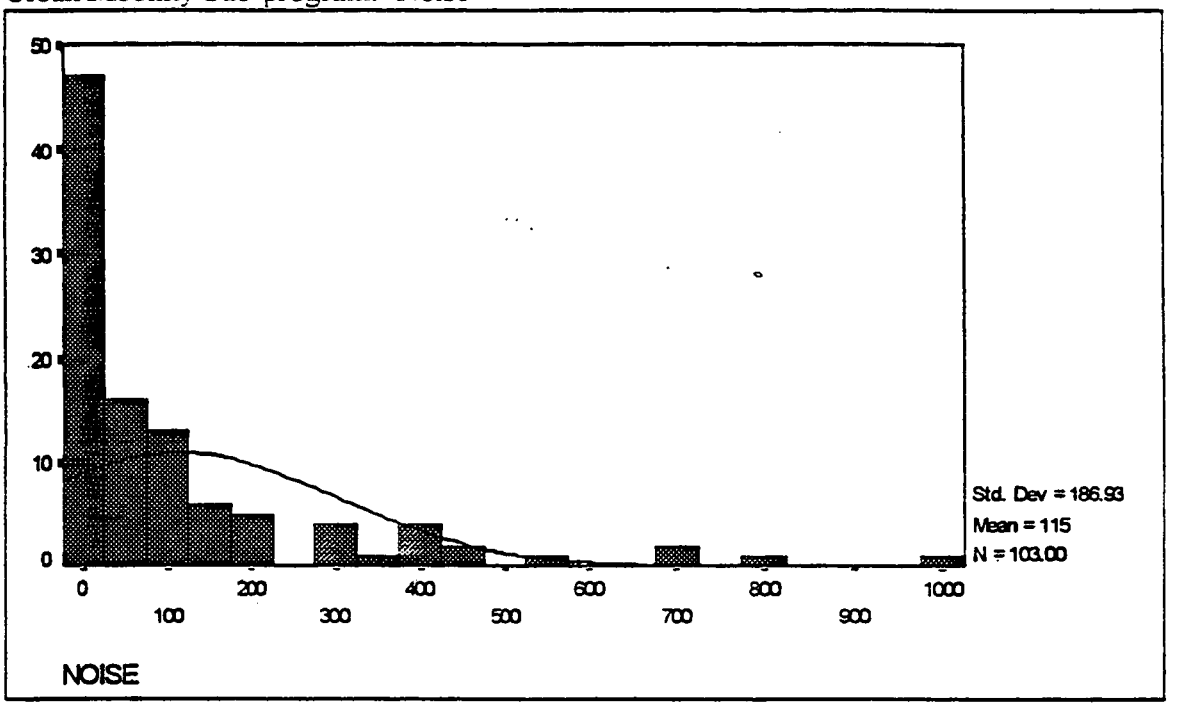


Figure F-2. Urban Mobility Sub-Program Histograms (continued)

Urban Mobility Sub-program: Noise



Urban Mobility Sub-program: Noise - Truncated

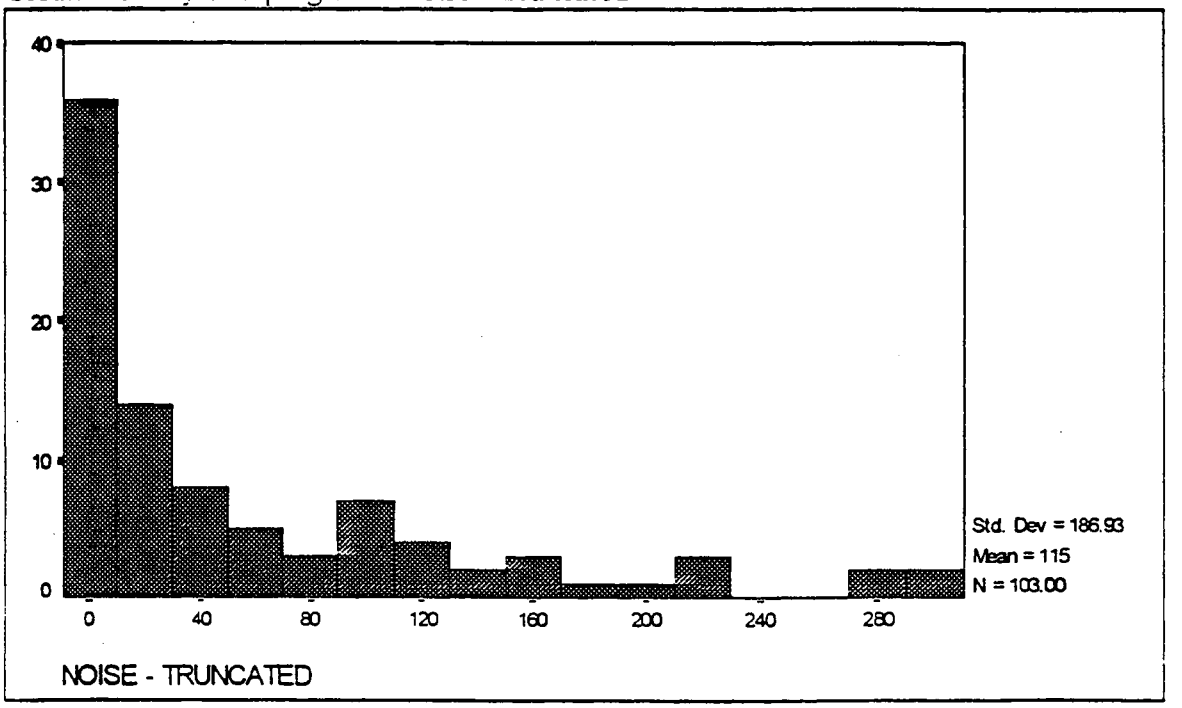
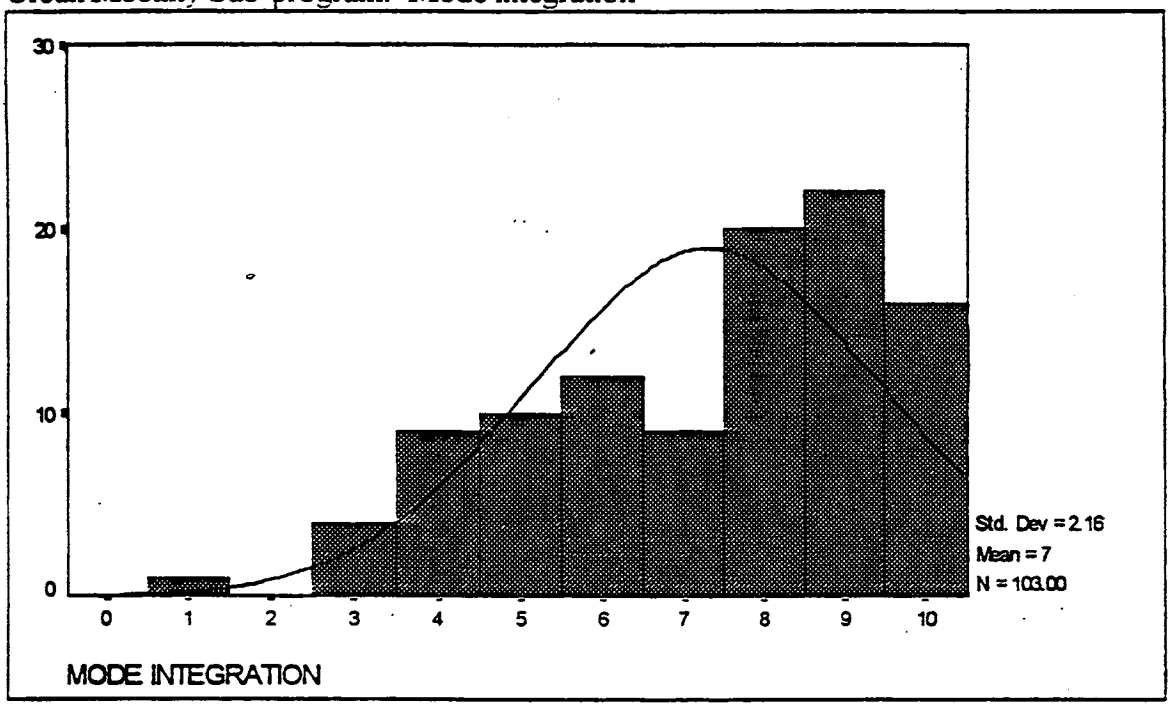


Figure F-2. Urban Mobility Sub-Program Histograms (continued)

Urban Mobility Sub-program: Mode integration



Urban Mobility Sub-program: Land use

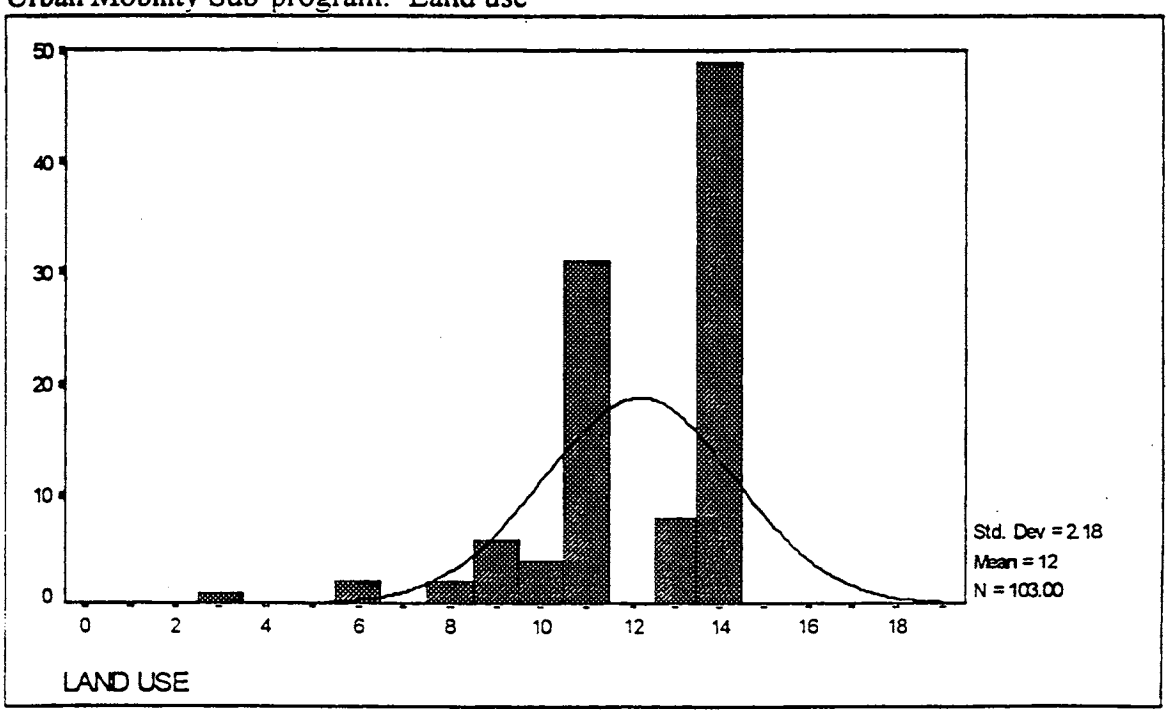
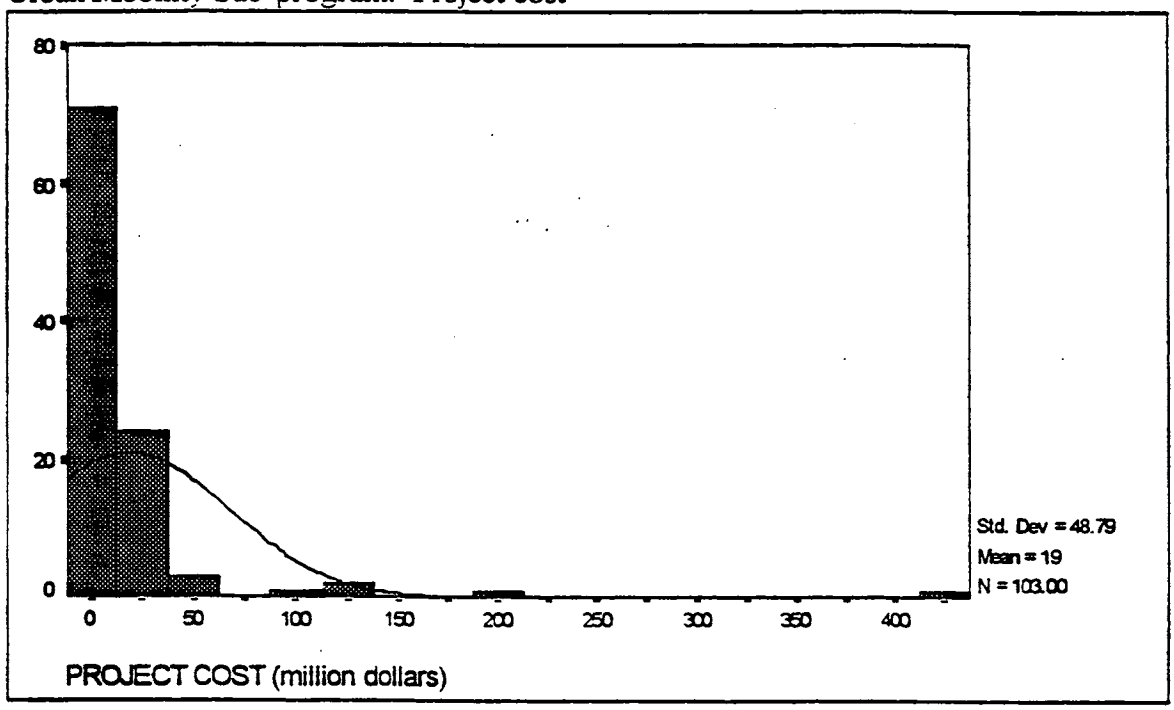


Figure F-2. *Urban Mobility Sub-Program Histograms (continued)*

Urban Mobility Sub-program: Project cost



Urban Mobility Sub-program: Project net present value

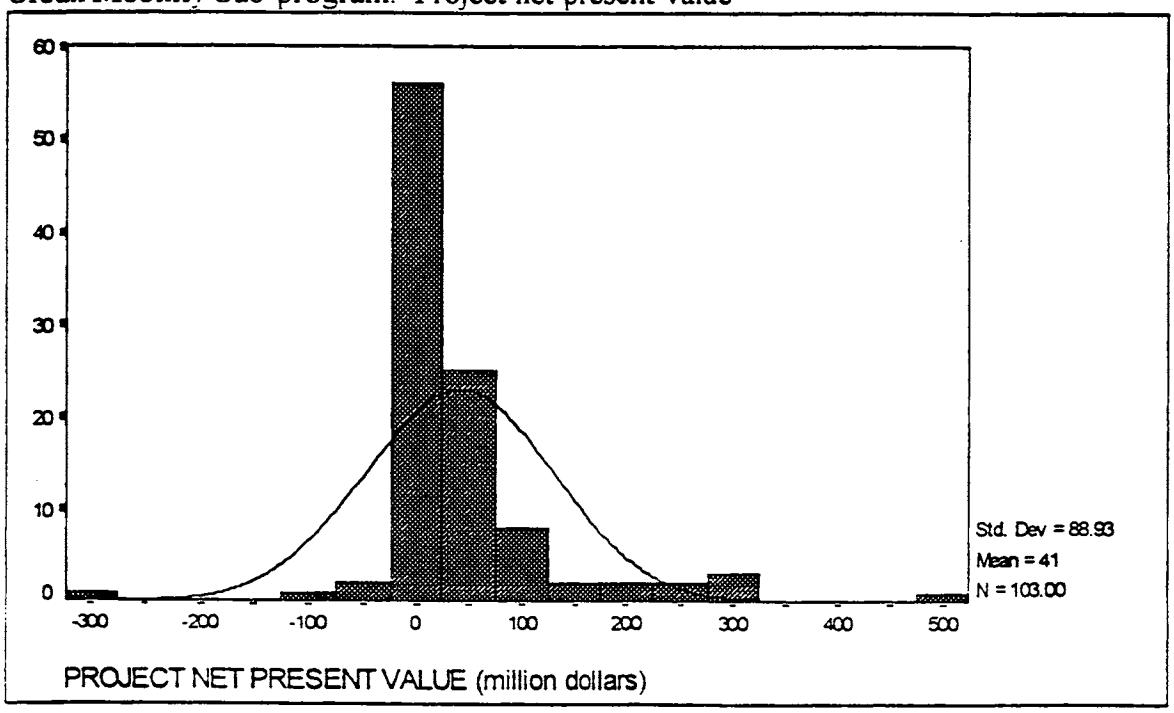


Figure F-2. Urban Mobility Sub-Program Histograms (continued)

APPENDIX G. ALTERNATE PRIORITIZATION EXAMPLES

Table G-1. Rural Alternate Prioritization Example

			Budget Allocation: $120 million			Budget Allocation: $150 million		
I.D.	Type	cost	TOPSIS	OPT_NPV	OPT_B/C, >1.0	TOPSIS	OPT_NPV	OPT_B/C, >1.0
1	truck climbing lane	503,109	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
2	truck climbing lane	1,096,800	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
3	widening	1,355,750	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
4	truck climbing lane	5,270,516	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
5	passing lane	595,400	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
6	widening	1,950,000	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
7	widening	6,662,500	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
8	widening	6,889,155	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
9	widening	8,012,319	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
10	widening	35,995,000	*Funded*	*Funded*	-	*Funded*	*Funded*	*Funded*
11	truck climbing lane	1,592,464	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
12	interchange	14,500,000	*Funded*	-	*Funded*	*Funded*	*Funded*	*Funded*
13	interchange	797,000	*Funded*	-	*Funded*	*Funded*	*Funded*	*Funded*
14	widening	850,000	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
15	park and ride lot	1,271,000	*Funded*	-	-	*Funded*	-	-
16	truck climbing lane	372,879	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
17	widening	20,565,000	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
18	traffic circulation	6,377,000	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
19	passing lane	644,600	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
20	widening	4,516,000	*Funded*	-	*Funded*	*Funded*	*Funded*	*Funded*
21	truck climbing lane	912,000	-	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
22	truck climbing lane	1,868,900	-	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
23	TWLTL	338,000	-	-	*Funded*	*Funded*	-	*Funded*
24	truck climbing lane	1,391,801	-	-	*Funded*	*Funded*	*Funded*	*Funded*
25	widening	1,516,640	-	-	*Funded*	*Funded*	*Funded*	*Funded*
26	passing lane	599,400	-	-	*Funded*	*Funded*	*Funded*	*Funded*
27	widening	1,069,260	-	*Funded*	*Funded*	*Funded*	*Funded*	*Funded*
28	widening	3,382,000	-	-	-	*Funded*	-	-
29	pace lane	2,366,000	-	-	-	*Funded*	-	-
30	widening	17,450,000	-	-	-	-	-	-
31	by-pass	5,401,792	-	-	-	-	-	-
32	passing lane	623,540	-	-	*Funded*	-	*Funded*	*Funded*
33	widening	9,915,350	-	-	-	-	-	-
34	widening	24,307,500	-	-	-	-	-	-
35	widening	1,150,000	-	-	-	-	-	-
36	passing lane	290,900	-	-	-	-	-	-
37	passing lane	299,800	-	-	-	-	-	-
38	interchange	12,920,000	-	-	-	-	-	-
39	passing lane	587,900	-	-	-	-	-	-
40	widening	17,331,550	-	*Funded*	*Funded*	-	*Funded*	*Funded*
41	passing lane	765,110	-	-	-	-	-	-
42	by-pass	28,534,000	-	-	-	-	-	-
43	widening	12,078,200	-	-	-	-	-	-
44	interchange	8,000,000	-	-	-	-	-	-
45	realignment	1,176,000	-	-	-	-	-	-
46	realignment	2,067,000	-	-	-	-	-	-
47	realignment	1,561,000	-	-	-	-	-	-
48	widening	17,300,000	-	-	-	-	-	-
49	truck climbing lane	2,879,000	-	-	*Funded*	-	-	*Funded*
50	widening	9,508,800	-	-	-	-	-	-
51	SC&DI	2,386,000	-	-	*Funded*	-	-	*Funded*
52	widening	1,062,000	-	-	-	-	-	-
53	widening	16,208,740	-	-	-	-	-	-
54	widening	18,053,000	-	-	-	-	-	-

Table G-1. Rural Alternate Prioritization Example (continued)

			Budget Allocation: $120 million			Budget Allocation: $150 million		
I.D.	Type	cost	TOPSIS	OPT_NPV	OPT_B/C, >1.0	TOPSIS	OPT_NPV	OPT_B/C, >1.0
55	widening	12,502,525	-	-	-	-	-	-
56	passing lane	1,047,864	-	-	-	-	-	-
57	widening	34,000,000	-	-	-	-	-	-
58	truck climbing lane	5,655,000	-	-	-	-	-	-
59	interchange	6,049,480	-	-	*Funded*	-	*Funded*	*Funded*
60	widening	38,498,000	-	-	-	-	-	-
61	interchange	777,230	-	-	-	-	-	-
62	truck climbing lane	3,789,000	-	-	-	-	-	-
63	interchange	26,838,000	-	-	-	-	-	-
64	realignment	15,960,000	-	-	-	-	-	-

***Note Project i.d.'s are assigned in descending rank order as produced by the TOPSIS algorithm (i.e., the priority index) and WSDOT's Mobility method.

Exhibit G-1. Manual Comparison Example (@ $150million):

Project Nos. 32 & 40 are Funded ONLY by the two optimization methods.
Project Nos. 28 & 29 are Funded by WSDOT's Mobility Prioritization Method (TOPSIS).

Consider:	B/C	Cmty	Wets	Water Q.	Noise	Mode	Landuse
(*) Top 10th percentile	*>18.9*	*<2*	*0.5*	*<1.0*	*0*	*<6.5*	*>14*
(+) Top 25%	*>3.49*	*<4*	*0.5*	*<6.3*	*0*	*<8*	*>13.5*
(-) Bottom 25%	*<0.5*	*>5*	*>2.5*	*>15.4*	*>22*	*>9*	*<9.0*
(#) Bottom 10%	*<0.27*	*>6*	*>11.9*	*>24*	*>107*	*>10*	*<4.5*

Input Scores with percentiles:

ID	B/C	Cmty	Wets	Water Q.	Noise	Mode	Landuse
	65%	*14%*	*2.6%*	*2.6%*	*2.6%*	*7%*	*8%*
28	0.83	3 (+)	2.5 (-)	27 (#)	3	9 (-)	14 (*)
29	0.78	3 (+)	0.5 (*)	0.5 (*)	25 (-)	10 (#)	5 (-)
32	1.61	4 (+)	0.5 (*)	15	0 (*)	10 (#)	11
40	3.9 (+)	8 (#)	24 (#)	16 (-)	408 (#)	9 (-)	14 (*)

ID	*Total Weight carried in bottom 10%*	*...carried in bottom 25%*	*...carried in top 25%*	*...carried in top 10%*
28	2.6	12.2	22	8
29	7	17.6	19.5	5.2
32	7	7	19.5	5.2
40	19.2	28.8	73	8

Note how it is apparently the degree of weight carried in the bottom 10th percentile that makes the difference in rank order. In particular, for Project No.40 using the Mobility method (where it ranks lowest of the four) and also for Project No.28 (which ranks highest of the four).

Table G-2. Urban Alternate Prioritization Example

			Budget Allocation: $120 million			Budget Allocation: $150 million		
I.D.	Type	cost	TOPSIS	OPT_NPV	OPT_B/C, >1.0	TOPSIS	OPT_NPV	OPT_B/C, >1.0
1	widening	1,014,000	Funded	Funded	Funded	Funded	Funded	Funded
2	widening	1,217,000	Funded	Funded	Funded	Funded	Funded	Funded
3	interchange	3,253,200	Funded	Funded	Funded	Funded	Funded	Funded
4	ramp	505,336	Funded	Funded	Funded	Funded	Funded	Funded
5	widening	7,706,016	Funded	Funded	Funded	Funded	Funded	Funded
6	interchange	1,360,000	Funded	Funded	Funded	Funded	Funded	Funded
7	widening	2,801,803	Funded	Funded	Funded	Funded	Funded	Funded
8	intersection	626,730	Funded	Funded	Funded	Funded	Funded	Funded
9	right-turn lane	168,000	Funded	Funded	Funded	Funded	Funded	Funded
10	extension	500,000	Funded	Funded	Funded	Funded	Funded	Funded
11	widening	3,441,469	Funded	Funded	Funded	Funded	Funded	Funded
12	widening	2,948,500	Funded	Funded	Funded	Funded	Funded	Funded
13	TSM	4,052,000	Funded	Funded	Funded	Funded	Funded	Funded
14	HOV	200,000	Funded	Funded	Funded	Funded	Funded	Funded
15	interchange	13,000,000	Funded	Funded	Funded	Funded	Funded	Funded
16	widening	4,695,530	Funded	Funded	Funded	Funded	Funded	Funded
17	interchange	3,540,589	Funded	Funded	Funded	Funded	Funded	Funded
18	interchange	460,000	Funded	Funded	Funded	Funded	Funded	Funded
19	interchange	4,157,504	Funded	Funded	Funded	Funded	Funded	Funded
20	O-xing	9,104,160	Funded	Funded	Funded	Funded	Funded	Funded
21	widening	3,608,693	Funded	Funded	Funded	Funded	Funded	Funded
22	intersection	1,056,000	Funded	Funded	Funded	Funded	Funded	Funded
23	interchange	10,180,799	Funded	Funded	Funded	Funded	Funded	Funded
24	interchange	4,215,120	Funded	Funded	Funded	Funded	Funded	Funded
25	HOV	6,409,000	Funded	Funded	Funded	Funded	Funded	Funded
26	rechannelization	2,090,000	Funded	Funded	Funded	Funded	Funded	Funded
27	widening	2,925,000	Funded	-	Funded	Funded	Funded	Funded
28	widening	4,792,000	Funded	-	Funded	Funded	Funded	Funded
29	widening	14,573,000	Funded	Funded	-	Funded	Funded	-
30	widening	6,839,000	-	Funded	-	Funded	Funded	Funded
31	widening	5,467,000	-	Funded	Funded	Funded	Funded	Funded
32	widening	10,232,000	-	-	-	Funded	Funded	-
33	widening	2,800,000	-	-	Funded	Funded	-	Funded
34	widening	7,565,730	-	-	-	Funded	Funded	Funded
35	widening	4,210,000	-	-	Funded	-	Funded	Funded
36	interchange	3,260,000	-	-	Funded	-	-	Funded
37	widening	5,800,941	-	-	-	-	-	-
38	I/C & widening	29,488,000	-	-	-	-	-	-
39	widening	15,800,000	-	-	-	-	-	-
40	widening	15,138,675	-	-	-	-	-	-
41	widening	8,077,000	-	-	-	-	-	-
42	interchange	37,765,775	-	-	-	-	-	-
43	widening & HOV	17,998,000	-	-	-	-	-	-
44	interchange	13,281,000	-	-	-	-	-	-
45	interchange	1,248,000	-	-	-	-	-	-
46	interchange	5,860,000	-	-	-	-	-	-
47	interchange	17,589,000	-	-	-	-	-	-
48	channelization	1,399,000	-	-	Funded	-	-	Funded
49	widening	45,813,311	-	-	-	-	-	-
50	widening	13,578,000	-	-	-	-	-	-
51	widening	8,046,000	-	-	-	-	-	-
52	on-ramp	1,435,000	-	-	-	-	-	-
53	HOV	130,130,000	-	-	-	-	-	-
54	truck climbing lane	864,529	-	-	Funded	-	Funded	Funded
55	truck climbing lane	383,936	-	Funded	Funded	-	-	Funded
56	TWLTL	362,265	-	Funded	Funded	-	-	Funded
57	widening	2,106,000	-	-	-	-	-	-

Table G-2. Urban Alternate Prioritization Example (continued)

			Budget Allocation: $120 million			Budget Allocation: $150 million		
I.D.	Type	cost	TOPSIS	OPT_NPV	OPT_B/C, >1.0	TOPSIS	OPT_NPV	OPT_B/C, >1.0
58	widening	3,478,555	-	-	-	-	-	*Funded*
59	widening	12,209,000	-	-	-	-	-	-
60	widening	4,850,000	-	-	-	-	-	-
61	park and ride lot	6,503,000	-	-	-	-	-	-
62	widening	10,967,191	-	-	-	-	-	-
63	widening	21,541,000	-	-	-	-	-	-
64	widening	13,295,000	-	-	-	-	-	-
65	interchange	21,000,000	-	-	-	-	-	-
66	truck climbing lane	455,750	-	-	*Funded*	-	-	*Funded*
67	park and ride lot	5,750,000	-	-	-	-	-	-
68	interchange	17,686,000	-	-	-	-	-	-
69	widening	3,988,000	-	-	-	-	-	-
70	interchange	5,161,800	-	-	-	-	-	-
71	TWLTL	500,300	-	-	*Funded*	-	-	*Funded*
72	auxiliary lane	4,031,000	-	-	-	-	-	*Funded*
73	TWLTL and access	5,657,000	-	-	-	-	-	-
74	TWLTL	2,345,346	-	-	-	-	-	*Funded*
75	widening	25,309,000	-	-	-	-	-	-
76	auxiliary lane	16,035,000	-	-	-	-	-	-
77	interchange	9,577,157	-	-	-	-	-	-
78	widening	3,400,000	-	-	-	-	-	-
79	widening	8,241,551	-	-	-	-	-	-
80	connection	27,500,000	-	-	-	-	-	-
81	interchange	10,899,500	-	-	-	-	-	-
82	truck climbing lane	3,574,000	-	-	-	-	-	-
83	interchange	29,155,000	-	-	-	-	-	-
84	interchange	15,085,000	-	-	-	-	-	-
85	interchange	8,138,550	-	-	-	-	-	-
86	interchange	8,606,000	-	-	-	-	-	-
87	widening	30,456,000	-	-	-	-	-	-
88	widening	2,974,390	-	-	-	-	-	-
89	widening	11,142,272	-	-	-	-	-	-
90	widening	28,554,240	-	-	-	-	-	-
91	interchange	5,876,000	-	-	-	-	-	-
92	widening	36,220,000	-	-	-	-	-	-
93	interchange	30,684,000	-	-	-	-	-	-
94	widening	10,553,000	-	-	-	-	-	-
95	widening	3,630,000	-	-	-	-	-	-
96	widening	18,722,000	-	-	-	-	-	-
97	widening	7,914,000	-	-	-	-	-	-
98	widening	421,200,000	-	-	-	-	-	-
99	extension	196,030,000	-	-	-	-	-	-
100	new alignment	46,186,400	-	-	-	-	-	-
101	widening	121,868,000	-	-	-	-	-	-
102	widening	109,584,000	-	-	-	-	-	-
103	widening	19,778,000	-	-	-	-	-	-

APPENDIX H. VISUAL BASIC MACROS AND SAMPLE OUTPUT

```
' VaryErrorChg Macro
' written by TReed, 12/5/95 -modified 12/20/95
' Changes the random error mean,st.dev. in PERCENT ERROR terms.
' *Automatically goes  to Sheet1.
' **Can be revised for normally distributed %error simulations by using 'mary' and the
'       CheckNeg subroutine.  In order to modify the STD.DEV cases the user MUST edit this
'       macro. User must also edit for input length.

Dim mary As Variant
Dim june As Variant

Sub VaryErrorChg()
   Sheets("Sheet1").Select
   For k = 1 To 5    'loop for No. of cases desired
     For j = 1 To 15    'loop for No. of iterations desired
'  Each iteration consumes 6 columns in sheet2.  Combined, loops must use < 415 columns
     Range("L11:l74").Select
     Selection.Clear
     Select Case k
       Case 1
'          mary = 0.025
'          -0.2877 is ln(0.75) i.e., 25% error, -0.3567 is 30%, and -0.4308 is 35%
          Application.ExecuteExcel4Macro String:= _
            "Random([rln_bc2.xls]Sheet1!r11c12:r74c12,  1,  64,  2,  ,  0,  -0.2877)"
            'third number in this command is the type of distribution to select from
            'last two numbers in this command are the mean, and standard deviation
          Range("c11:c74").Select
          Selection.Copy
          CheckZeroEquation
'          CheckNeg
       Case 2
'          mary = 0.05
          Application.ExecuteExcel4Macro String:= _
            "Random([rln_bc2.xls]Sheet1!r11c12:r74c12,  1,  64,  2,  ,  0,  -0.3567)"
          Range("c11:c74").Select
          Selection.Copy
          CheckZeroEquation
'          CheckNeg
       Case 3
'          mary = 0.10
          Application.ExecuteExcel4Macro String:= _
            "Random([rln_bc2.xls]Sheet1!r11c12:r74c12,  1,  64,  2,  ,  0,  -0.4308)"
          Range("c11:c74").Select
          Selection.Copy
          CheckZeroEquation
'          CheckNeg
       Case 4
```

```
'           mary = 0.15
            Application.ExecuteExcel4Macro String:= _
              "Random([rln_bc2.xls]Sheet1!r11c12:r74c12,  1,  64,  2,  ,  0,  -0.1625)"
            Range("c11:c74").Select
            Selection.Copy
            CheckZeroEquation
'           CheckNeg
          Case 5
'           mary = 0.20
            Application.ExecuteExcel4Macro String:= _
              "Random([rln_bc2.xls]Sheet1!r11c12:r74c12,  1,  64,  2,  ,  0,  -0.2231)"
            Range("c11:c74").Select
            Selection.Copy
            CheckZeroEquation
'           CheckNeg
        End Select
        Range("m11:m74").Select
        Selection.Copy
        Range("o11").Select
        Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, _
          SkipBlanks:=False, Transpose:=False
'
' next section should label the standard deviation in first cell of iteration
        Sheets("Sheet2").Select
        ActiveCell.FormulaR1C1 = "Std.Dev."
        ActiveCell.Offset(1, 0).Range("A1").Select
        ActiveCell.FormulaR1C1 = k
        ActiveCell.Offset(-1, 0).Range("A1:A2").Select
        With Selection
          .HorizontalAlignment = xlCenter
          .VerticalAlignment = xlBottom
          .WrapText = False
          .Orientation = xlHorizontal
        End With
        With Selection.Borders(xlLeft)
          .Weight = xlThick
          .ColorIndex = xlAutomatic
        End With
        ActiveCell.Offset(0, 1).Range("A1").Select
        Sheets("Sheet1").Select
' end of labeling section {returns to the criteria worksheet}
        Range("n8:v74").Select
        Application.Run Macro:=Range("rln_bc2.xls!Topsis__t")
        Sheets("Sheet1").Select
        Next j
      Next k
End Sub          ' End of VaryErrorChg Macro.
```

```
' CheckZeroEquation Macro
' Use for logNormal simulations
' written by T.Reed 12/29/95
'
Sub CheckZeroEquation()
   Range("m11:m74").Select 'corresponds to copied category score
   'Range("m11").Select
   Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, _
      SkipBlanks:=False, Transpose:=False
   For Each Cell In Selection
   If Cell.Value = 0 Then
      Cell.Clear
      Cell.FormulaR1C1 = "=exp(0+RC[-1])"
   Else
      june = Cell.Value
      Cell.Clear
      Cell.FormulaR1C1 = "=exp(ln(" & june & ")+rc[-1])"
   End If
   Next Cell
End Sub



' CheckNeg routine
' Use to truncate a normally distributed percent error.
' written 12/13 with MS help
'
Sub CheckNeg()
   bob = 1
   Set first = Selection
   fad = first.Address()
   For Each Cell In Selection
   If Cell.Value <= 0 Then
      Cell.Clear
      Application.ExecuteExcel4Macro String:= _
         "random([rln_bc2.xls]Sheet1!" & Cell.Address(, , xlR1C1) & ", 1, 1, 2, , 1," & mary &
")"
      bob = bob + 1
   End If
   Next Cell
   If bob > 1 Then
      Range("" & fad & "").Select
      Application.OnTime Now + TimeValue("00:00:01"), "CheckNeg"
   End If
End Sub
```

```
' ChgWeights macro
' written T.Reed 11/29/95
'
Dim j As Integer
Dim k As Integer

Sub ChgWeights()
   MsgBox "User must manually edit for length of input file ", , "Alert"
   Application.Run macro:=("ResetOutput")
   For j = 1 To 6 'begin loop for no. of cases you want to test
   Sheets("Sheet1").Select
   Range(Cells(6, 4), Cells(6, 10)).Select
   Selection.Copy
   Range(Cells(9, 4), Cells(9, 10)).Select
   ActiveSheet.Paste
      For k = 4 To 10
      Cells(9, k).Select
      x = Cells(6, k) 'original WSTC catweights
'redistribute weight evenly or proportionately across each other category. The cases are
'modified for each different weight scenario.
      Select Case j
         Case 1
            w = 0.65 * 0.1    'ten percent of cost-efficiency to cmtysupport
            If k = 4 Then y = x - w
            If k = 5 Then y = x + w
            If k < 9 And k > 5 Then y = x
            If k > 8 Then y = x
            ActiveCell.FormulaR1C1 = y
         Case 2    'ten percent from each other category to cmtysupport
            w = (0.65 * 0.1) + (0.08 * 0.1) + (0.07 * 0.1) + (0.06 * 0.1)
            If k = 4 Then y = x - (x * 0.1)
            If k = 5 Then y = x + w  'equals 22.6 percent of 100
            If k < 9 And k > 5 Then y = x - (x * 0.1)
            If k > 8 Then y = x - (x * 0.1)
            ActiveCell.FormulaR1C1 = y
         Case 3
            w = 0.08 * 0.1 '10 percent of environ redistributed
            If k = 4 Then y = x
            If k = 5 Then y = x + w
            If k < 9 And k > 5 Then y = x - (x * 0.1)
            If k > 8 Then y = x
            ActiveCell.FormulaR1C1 = y
         Case 4
            w = 0.07 * 0.1 'ten percent of modeint. redistributed
            If k = 4 Or k = 10 Then y = x
            If k = 5 Then y = x + w
            If k < 9 And k > 5 Then y = x
```

```
            If k = 9 Then y = x - w
            ActiveCell.FormulaR1C1 = y
        Case 5
            w = 0.06 * 0.1    'ten percent of landuse redistributed to cmtysupport
            If k = 4 Or k = 9 Then y = x
            If k = 5 Then y = x + w
            If k < 9 And k > 5 Then y = x
            If k = 10 Then y = x - w
            ActiveCell.FormulaR1C1 = y
        Case 6    'cmty and modeint. switch org.WSTC weights
            If k = 5 Then y = 0.07
            If k = 9 Then y = 0.14
            If k = 4 Or k > 5 And k < 9 Or k = 10 Then y = x
            ActiveCell.FormulaR1C1 = y
    End Select
    Next k
  Range("c8:k74").Select    'MUST edit this line when numprojects to analyze changes!!
  Application.Run macro:=Range("WEIGHTS6.XLS!TOPSIS__t")
  Next j
  Application.Run macro:=("Label")
End Sub
```

*** These first two macros require a data input worksheet (called 'Sheet1') formatted to match and an empty, initialized output worksheet (called 'Sheet2') in the same Excel 5.0 workbook. The following three macros are subroutines utilized by the second.
***

```
' Borders Macro
' written by T.Reed 11/30/95
'
Sub Borders()
  ActiveCell.Range("A1").Select
  Selection.Font.Bold = True
  ActiveCell.Range("A1:A2").Select
  With Selection.Borders(xlLeft)
    .Weight = xlThick
    .ColorIndex = xlAutomatic
  End With
End Sub
```

```
' ResetOutput Macro
' Macro recorded 11/30/95 by University of Washington
'
Sub ResetOutput()
    Sheets("Sheet2").Select
    ActiveCell.Cells.Select
    Selection.Clear
    ActiveCell.Select
End Sub
```

```
' Label Macro
' Macro recorded 11/30/95 by University of Washington
' modified by T.Reed
'
Sub Label()
    Sheets("Sheet2").Select
    ActiveCell.Rows("1:1").EntireRow.Select
    Selection.Insert Shift:=xlDown
    ActiveCell.Select
    ActiveCell.FormulaR1C1 = "'10% redistributed"
    Application.Run macro:=("Borders")
    ActiveCell.Offset(0, 5).Range("A1").Select
    ActiveCell.FormulaR1C1 = "'10% redistributed"
    Application.Run macro:=("Borders")
    ActiveCell.Offset(0, 5).Range("A1").Select
    ActiveCell.FormulaR1C1 = "'10% redistributed"
    Application.Run macro:=("Borders")
    ActiveCell.Offset(0, 5).Range("A1").Select
    ActiveCell.FormulaR1C1 = "'10% redistributed"
    Application.Run macro:=("Borders")
    ActiveCell.Offset(0, 5).Range("A1").Select
    ActiveCell.FormulaR1C1 = "'Bait and switch"
    Application.Run macro:=("Borders")
    MsgBox "That is the End!, " & "Now compute differences in rank.", , "Alert"
End Sub
```

```
' Absolute Value of Differences Macro
' Macro written 11/16/95 by Tracy Reed on "Innovations-EDM"
'
Sub ABVdiff()
   Sheets("AbV").Select
   Cells(1, 1).Select      'starts from corner cell in AbV sheet
   ActiveCell.FormulaR1C1 = "CALCULATE THE ABSOLUTE VALUE OF DEVIATION"
   FName = InputBox("Enter the sourcefile name:", "Prompt")  'must all be in this same
workbook
   SDCase = InputBox("Enter the number of cases:", "Prompt")
   NumIts = InputBox("Enter the number of topsis iterations/case:", "Prompt")
   Projs = InputBox("Enter the number of projects to analyze:", "Prompt")
   Range("A2").Select
   ActiveCell.FormulaR1C1 = "BASE"
   Range("A4").Select
   For m = 1 To Projs
   ActiveCell.FormulaR1C1 = m
   N = 4 + m
   Cells(N, 1).Select
   Next m
   Cells(N + 1, 1).FormulaR1C1 = Projs
   Cells(N + 3, 1).FormulaR1C1 = "CASE:"
   p = -3
   For s = 1 To SDCase
   Sheets("AbV").Select    'again for each iteration
   Cells(N + 3, 2).FormulaR1C1 = s
   counter = 0
   x = 2
      For q = 1 To NumIts      'begin q loop.
      p = p + 5 'CHANGED from TEMP.xls
      counter = counter + 2
      Cells(2, counter).Select
      ActiveCell.FormulaR1C1 = "RUN #"
      Select Case q
         Case 1
            Cells(3, q + 1).Select
            ActiveCell.FormulaR1C1 = q
            Sheets(FName).Select
            Range(Cells(3, p), Cells(m + 2, p)).Select
            Selection.Copy
            Sheets("AbV").Select
            Cells(4, q + 1).Select
            ActiveSheet.Paste
         Case Else
            Cells(3, counter).Select
            ActiveCell.FormulaR1C1 = q
            Sheets(FName).Select
```

```
            Range(Cells(3, p), Cells(m + 2, p)).Select
            Selection.Copy
            Sheets("AbV").Select
            Cells(4, counter).Select
            ActiveSheet.Paste
        End Select
'following puts in Absolute Value calculations
        Cells(2, 1 + counter).Select
        ActiveCell.FormulaR1C1 = "Ab.Value"
        Cells(4, 1 + counter).FormulaR1C1 = "=ABS(RC1-RC[-1])"
        Cells(4, 1 + counter).Select
        Selection.AutoFill Destination:=Range(Cells(4, 1 + counter), Cells(m + 2, 1 + counter)), _
          Type:=xlFillDefault 'where m+2 is, there used to be just 67.
        Cells(m + 3, 1 + counter).Select
        ActiveCell.FormulaR1C1 = "=sum(r1c:r[-1]c)/r[1]c1" ' &-m& doesn't work, was [-65]
        Selection.Copy
        x = x + 1
        Cells(N + 3, x).Select
        Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, _
          SkipBlanks:=False, Transpose:=False
        Next q
    Columns("B:Z").EntireColumn.AutoFit
    Range(Cells(N + 3, 1), Cells(N + 3, x)).Copy
    Sheets("AbV_table").Select
    Cells(s + 1, 1).Select
    ActiveSheet.Paste
    Next s
    Sheets("AbV").Select
    Columns("B:Z").EntireColumn.AutoFit
    Sheets("AbV_table").Select
    Range("A1").Select
    ActiveCell.FormulaR1C1 = "Absolute Value of Difference"
    MsgBox "That is the End!, " & "Use this data for graphics.", , "Alert"
    Cells(3, 1).Select
'
End Sub
```

```
' Funded Project Comparisons Macro
' Macro written 11/16/95 by Tracy Reed on "Innovations-EDM", MODIFIED 12/20
' 29 PROJECTS were ORIGINALLY. FUNDED in 95-97 RURAL SET
'
Sub Funded()
   Sheets("Funded").Select
   Cells(1, 1).Select      'starts from corner cell in "Funded" sheet
   ActiveCell.FormulaR1C1 = "Compare Funded Set of Projects"
   FName = InputBox("Enter the source filename:", "Prompt") 'must all be in this same
workbook
   SDCase = InputBox("Enter the number of cases:", "Prompt")
   NumIts = InputBox("Enter the number of topsis iterations/case:", "Prompt")
   Projs = InputBox("Enter the number of projects to analyze:", "Prompt")
   NumFun = InputBox("Enter the number of projects originally funded:", "Prompt")
   Range("A2").Select
   ActiveCell.FormulaR1C1 = "BASE"
'  a = 0, could init. q, s, m OR Dim as integers
   Range("A4").Select
' begin base loop, writes numbers in left column
   For m = 1 To Projs
      ActiveCell.FormulaR1C1 = m
      N = 4 + m
      Cells(N, 1).Select
'     If m > 1 And m < NumFun Then a = 1 + m  'adds up the funded project i.d.'s (+1 extra)
   Next m
'end base loop, 'a' not used now
   Cells(N + 1, 1).FormulaR1C1 = NumFun
   Cells(N + 3, 1).FormulaR1C1 = "CASE:"
   p = 0 'init.datafile column counter
'begin case loop
   For s = 1 To SDCase
   Sheets("Funded").Select  'again for each iteration
   Columns("B:AZ").EntireColumn.Clear
   Cells(N + 3, 2).FormulaR1C1 = s
   counter = 0 'init.working column counter
   x = 2 'init.column counter for pasting to "Fun_table"
      For q = 1 To NumIts      'begin q loop.
      p = p + 5    'rotate datafile counter
      y = 4 'initialize
      Rowcounter = 2    'init.the first project in priority order if funded
      If q = 1 Then
         counter = counter + 3
      Else
         counter = counter + 2
      End If
'begin pasting the runs next to one another on Funded worksheet
      Cells(2, counter - 1).Select
```

```
        ActiveCell.FormulaR1C1 = "RUN #"
        Cells(3, counter - 1).Select
        ActiveCell.FormulaR1C1 = q
        Sheets(FName).Select
        ActiveSheet.Cells(3, p).Select
        Do Until Cells(Rowcounter, p).Value = ""
          Rowcounter = Rowcounter + 1
        Loop
        ActiveSheet.Range(Cells(3, p), Cells(Rowcounter - 1, p)).Select
        Selection.Copy
        Sheets("Funded").Select
        Cells(4, counter - 1).Select
        ActiveSheet.Paste
'following calculates # of previously funded projects now dropped
          For y = 4 To Rowcounter + 1
          Match = 0
          temp = Cells(y, counter - 1) 'i.e., the proj no. in new rank order
          Cells(2, counter).Select
          ActiveCell.FormulaR1C1 = "Match"
          z = 4 'initialize
            For z = 4 To NumFun + 3
            If Cells(z, 1) = temp Then Match = 1
            Next z
          Cells(y, counter).FormulaR1C1 = Match
          Next y
        Cells(N + 1, counter).Select
        ActiveCell.FormulaR1C1 = "=(rc1)-(sum(r1c:r[-2]c))"  'when modifying CHECK HERE
        Selection.Copy
        x = x + 1
        Cells(N + 3, x).Select
        Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, _
          SkipBlanks:=False, Transpose:=False
'end computing # dropped
'begin calculating the number of additional projects funded with same budget
        Cells(N + 2, 1).Select
'subtract three b/c of 1 extra column header in datafiles
        ActiveCell.FormulaR1C1 = Rowcounter - 3
'this changes with each iteration, MUST paste to bottom row before next q
        Cells(N + 2, counter).Select
        ActiveCell.FormulaR1C1 = "=(rc1)-(r[-1]c1)" 'AND HERE
        Selection.Copy
        Cells(N + 4, x).Select
        Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, _
          SkipBlanks:=False, Transpose:=False
'end comparing gross number of projects
        Next q
'end of iteration loop
```

```
  Range(Cells(N + 3, 1), Cells(N + 4, x)).Copy
  Sheets("Fun_table").Select
  If s = 1 Then
    formatx = 2
  Else
    formatx = formatx + 2
  End If
  Cells(formatx, 1).Select
  ActiveSheet.Paste
  Next s
'end of case loop
  Sheets("Funded").Select
  Columns("B:Z").EntireColumn.AutoFit
  Sheets("Fun_table").Select
  Range("A1").Select
  ActiveCell.FormulaR1C1 = "How Many Previously Funded Projects were dropped? and
Number additional funded."
  MsgBox "That is the End!, " & "Use this data for graphics.", , "Alert"
  Cells(3, 1).Select
End Sub
```

*** These last two macros utilize data output from the Chgweights or VaryErrorChange macros and require four output worksheets named 'AbV,' 'AbV_table,' 'Funded,' and 'Fun_table' to compute the three measures of difference studied in this thesis. All macros operate in the same Excel 5.0 workbook. These samples are from the "WEIGHTS6.XLS" simulation.

*** Note that, as listed here in the appendix, these macros must be edited to accomodate the original output format of VaryErrorChange. ***

	A	B	C	D	E	F	G	H	I	J	K	L
1	2.5% error, run #15						5% error, run #1					
2	Std.Dev.	Priority Index	Rank Order by Code	Project cost	Total Budget	Funded Proj's	Std.Dev.	Priority Index	Rank Order by Code	Project cost	Total Budget	Funded Proj's
3	1	0.9588	1	503,109	150000000	1	2	0.958	1	503,109	150000000	1
4		0.6464	2	1,096,800	Remainings	2		0.629	2	1,096,800	Remainings	2
5		0.5561	3	1,355,750	10714175	3		0.592	3	1,355,750	11337715	3
6		0.4726	4	5,270,516		4		0.519	4	5,270,516		4
7		0.422	5	595,400		5		0.439	5	595,400		5
8		0.4021	6	1,950,000		6		0.379	6	1,950,000		6
9		0.3043	7	6,662,500		7		0.309	7	6,662,500		7
10		0.2633	8	6,889,155		8		0.27	8	6,889,155		8
11		0.1759	9	8,012,319		9		0.179	9	8,012,319		9
12		0.1505	10	35,995,000		10		0.164	10	35,995,000		10
13		0.1213	11	1,592,464		11		0.122	12	14,500,000		12
14		0.1168	12	14,500,000		12		0.121	11	1,592,464		11
15		0.1165	13	797,000		13		0.119	13	797,000		13
16		0.1093	14	850,000		14		0.11	14	850,000		14
17		0.1085	15	1,271,000		15		0.11	17	20,565,000		17
18		0.1077	16	372,879		16		0.11	15	1,271,000		15
19		0.1027	17	20,565,000		17		0.104	16	372,879		16
20		0.1019	18	6,377,000		18		0.104	19	644,600		19
21		0.1013	19	644,600		19		0.103	18	6,377,000		18
22		0.1011	20	4,516,000		20		0.102	20	4,516,000		20
23		0.1007	21	912,000		21		0.102	21	912,000		21
24		0.099	22	1,868,900		22		0.101	22	1,868,900		22
25		0.0966	23	338,000		23		0.098	24	1,391,801		24
26		0.0951	24	1,391,801		24		0.098	23	338,000		23
27		0.0928	26	599,400		26		0.094	25	1,516,640		25
28		0.092	25	1,516,640		25		0.093	26	599,400		26
29		0.0916	27	1,069,260		27		0.093	27	1,069,260		27
30		0.0902	28	3,382,000		28		0.092	28	3,382,000		28
31		0.0893	29	2,366,000		29		0.091	29	2,366,000		29
32		0.0891	31	5,401,792		31		0.09	31	5,401,792		31
33		0.0889	32	623,540		32		0.09	30	17,450,000		
34		0.0889	30	17,450,000				0.09	32	623,540		
35		0.0878	33	9,915,350				0.089	33	9,915,350		
36		0.0873	40	17,331,550				0.087	34	24,307,500		
37		0.0857	35	1,150,000				0.087	35	1,150,000		
38		0.0857	34	24,307,500				0.087	36	290,900		
39		0.0856	38	12,920,000				0.087	38	12,920,000		
40		0.0855	36	290,900				0.087	37	299,800		
41		0.0854	37	299,800				0.086	40	17,331,550		
42		0.0853	39	587,900				0.086	39	587,900		
43		0.0846	41	765,110				0.086	41	765,110		
44		0.0837	42	28,534,000				0.085	42	28,534,000		
45		0.0831	43	12,078,200				0.085	43	12,078,200		
46		0.0827	44	8,000,000				0.084	44	8,000,000		
47		0.0825	45	1,176,000				0.084	45	1,176,000		
48		0.0809	46	2,067,000				0.082	46	2,067,000		
49		0.08	47	1,561,000				0.081	47	1,561,000		
50		0.0793	48	17,300,000				0.08	48	17,300,000		
51		0.0784	49	2,879,000				0.08	49	2,879,000		
52		0.0783	50	9,508,800				0.079	50	9,508,800		
53		0.0777	51	2,386,000				0.078	52	1,062,000		
54		0.0774	52	1,062,000				0.078	51	2,386,000		
55		0.0769	53	16,208,740				0.078	53	16,208,740		
56		0.0762	54	18,053,000				0.077	56	1,047,864		
57		0.0757	56	1,047,864				0.077	55	12,502,525		
58		0.0757	55	12,502,525				0.076	57	34,000,000		
59		0.0752	57	34,000,000				0.076	54	18,053,000		
60		0.0747	58	5,655,000				0.076	58	5,655,000		
61		0.0744	59	6,049,480				0.075	59	6,049,480		
62		0.0731	60	38,498,000				0.074	60	38,498,000		
63		0.0703	61	777,230				0.071	61	777,230		
64		0.0668	62	3,789,000				0.068	62	3,789,000		
65		0.062	63	26,838,000				0.063	63	26,838,000		
66		0.0533	64	15,960,000				0.054	64	15,960,000		

Figure H-1. 'VaryErrorChange' or 'Chgweight' Sample Output

CALCULATE THE ABSOLUTE VALUE OF DEVIATION										
BASE	RUN #	Ab.Value	RUN #	Ab.Value	RUN #	Ab.Value	RUN #	Ab.Value	RUN #	Ab.Value
	1		2		3		4		5	
1	1	0	1	0	1	0	2	1	3	2
2	4	2	5	3	4	2	1	1	7	5
3	2	1	4	1	6	3	6	3	1	2
4	3	1	3	1	5	1	3	1	4	0
5	5	0	2	3	2	3	4	1	2	3
6	8	2	7	1	7	1	5	1	6	0
7	7	0	6	1	3	4	8	1	8	1
8	6	2	8	0	8	0	7	1	5	3
9	9	0	9	0	11	2	9	0	9	0
10	19	9	10	0	40	30	26	16	10	0
11	12	1	12	1	9	2	19	8	12	1
12	10	2	13	1	18	6	10	2	13	1
13	13	0	16	3	12	1	11	2	18	5
14	15	1	15	1	13	1	16	2	11	3
15	16	1	11	4	10	5	12	3	15	0
16	17	1	20	4	24	8	15	1	14	2
17	20	3	14	3	19	2	25	8	20	3
18	23	5	18	0	15	3	13	5	16	2
19	14	5	24	5	20	1	20	1	22	3
20	25	5	23	3	22	2	14	6	23	3
...	...	...	...	...	...	...	...	...	...	...
50	53	3	50	0	50	0	48	2	52	2
51	49	2	52	1	49	2	52	1	49	2
52	51	1	51	1	48	4	53	1	50	2
53	57	4	53	0	53	0	55	2	51	2
54	56	2	58	4	59	5	57	3	57	3
55	55	0	56	1	51	4	56	1	56	1
56	58	2	59	3	56	0	51	5	55	1
57	60	3	57	0	57	0	58	1	58	1
58	54	4	55	3	58	0	60	2	60	2
59	61	2	60	1	54	5	61	2	54	5
60	59	1	61	1	60	0	54	6	61	1
61	62	1	62	1	61	0	40	21	62	1
62	40	22	40	22	62	0	62	0	40	22
63	63	0	63	0	63	0	63	0	63	0
64	64	0	64	0	64	0	64	0	64	0
64		1.375		1.14063		1.51563		1.73438		1.3125
CASE:	2	2.5625	3	3.3125	3.71875	3.53125	2.344	2.6875	3.1875	3.1875

Figure H-2. 'AbV' Sample Worksheet

Absolute Value of Difference						
CASE:	1	0.40625	0.5	0.53125	0.438	0.1875
CASE:	2	0.375	0.65625	0.65625	0.75	0.875
Absolute Value of Difference						
CASE:	1	0.40625	0.5	0.53125	0.438	0.1875
CASE:	2	0.375	0.65625	0.65625	0.75	0.875
CASE:	3	0.8125	1	0.96875	1.156	1.125
CASE:	4	1.8125	1.4375	1.625	1.719	0.875
CASE:	5	2.15625	2.28125	1.59375	1.313	1.5625
Pct. Erron	25	2.28125	2.5	1.71875	2.594	2.6875
Pct. Erron	30	3.0625	2.5	2.25	2.469	1.84375
Pct. Erron	35	2.5625	3	3.3125	3.719	3.53125

Figure H-3. 'AbV_table' Sample Output

Compare Funded Set of Projects									
BASE	RUN #	Match	RUN #	Match	RUN #	Match	RUN #	Match	RUN #
	1		2		3		4		5
1	1	1	1	1	1	1	2	1	3
2	4	1	5	1	4	1	1	1	7
3	2	1	4	1	6	1	6	1	1
4	3	1	3	1	5	1	3	1	4
5	5	1	2	1	2	1	4	1	2
6	8	1	7	1	7	1	5	1	6
7	7	1	6	1	3	1	8	1	8
8	6	1	8	1	8	1	7	1	5
9	9	1	9	1	11	1	9	1	9
10	19	1	10	1	40	0	26	1	10
11	12	1	12	1	9	1	19	1	12
12	10	1	13	1	18	1	10	1	13
13	13	1	16	1	12	1	11	1	18
14	15	1	15	1	13	1	16	1	11
15	16	1	11	1	10	1	12	1	15
16	17	1	20	1	24	1	15	1	14
17	20	1	14	1	19	1	25	1	20
18	23	1	18	1	15	1	13	1	16
19	14	1	24	1	20	1	20	1	22
20	25	1	23	1	22	1	14	1	23
21	21	1	28	1	26	1	18	1	25
22	22	1	25	1	23	1	23	1	17
23	27	1	22	1	16	1	21	1	28
24	24	1	21	1	14	1	17	1	30
25	18	1	30	0	21	1	28	1	24
26	28	1	29	1	17	1	31	0	29
27	26	1	19	1	25	1	32	0	21
28	32	0	36	0	28	1	22	1	
29	30	0	32	0			59	0	
30	29	1	26	1			24	1	
31			31	0			29	1	
32			37	0					
33			39	0					
34									
35									
... *cut*	...								
60									
61									
62									
63									
64									
29		1		2		2		1	
32		3		3		3		3	
CASE:	2	1	2	2	1	3	3	1	1
		1	4	-1	2	-2	-1	2	0

Figure H-4. 'Funded' Sample Worksheet

How Many Previously Funded Projects were dropped? and Number additional funded.

CASE:	1	0	0	0	1	0							
		1	1	1	1	1	0						
CASE:	2	0	1	0	0	0							
		2	1	0	1	1	2						

How Many Previously Funded Projects were dropped?							Number additional funded.						
CASE:	1	0	0	0	1	0	CASE:	1	1	1	1	1	0
CASE:	2	0	1	0	0	0	CASE:	2	1	0	1	1	2
CASE:	3	0	0	0	2	1	CASE:	3	0	1	2	0	0
CASE:	4	2	1	1	2	1	CASE:	4	-1	0	0	0	0
CASE:	5	1	3	2	1	0	CASE:	5	0	-2	0	0	2
Pct. Err	25	1	4	2	2	1	Pct. Er	25	2	-3	0	2	1
Pct. Err	30	3	3	2	6	1	Pct. Er	30	0	-2	0	-4	1
Pct. Err	35	1	2	2	1	3	Pct. Er	35	1	4	-1	2	-2

Figure H-5. 'Fun_table' Sample Output

APPENDIX I. SIMULATION OUTPUT CHARTS

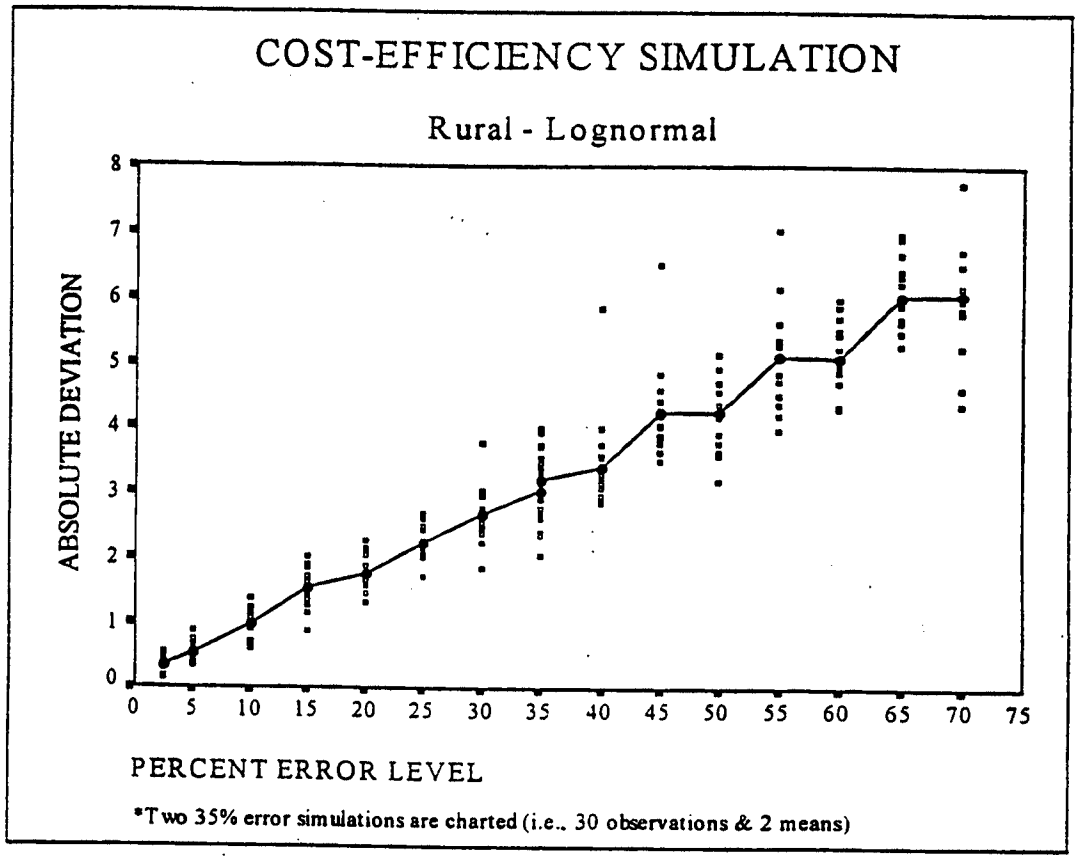
Contents:

- 7 point and line charts of raw output data for 2.5-35 percent error levels (i.e., one per category where the cost-efficiency simulation ranges up to 65 percent error).

- 14 bar charts of mean nos. funded for 2.5-35 percent error levels (i.e. 7 for 'now dropped' and 7 for 'additional' where the cost-efficiency simulation ranges up to 65 percent error).

- 21 measure of difference boxplots, 3 per category (i.e., one of each summary measure).

- 24 error level boxplots, 3 per level (i.e., one of each summary measure).



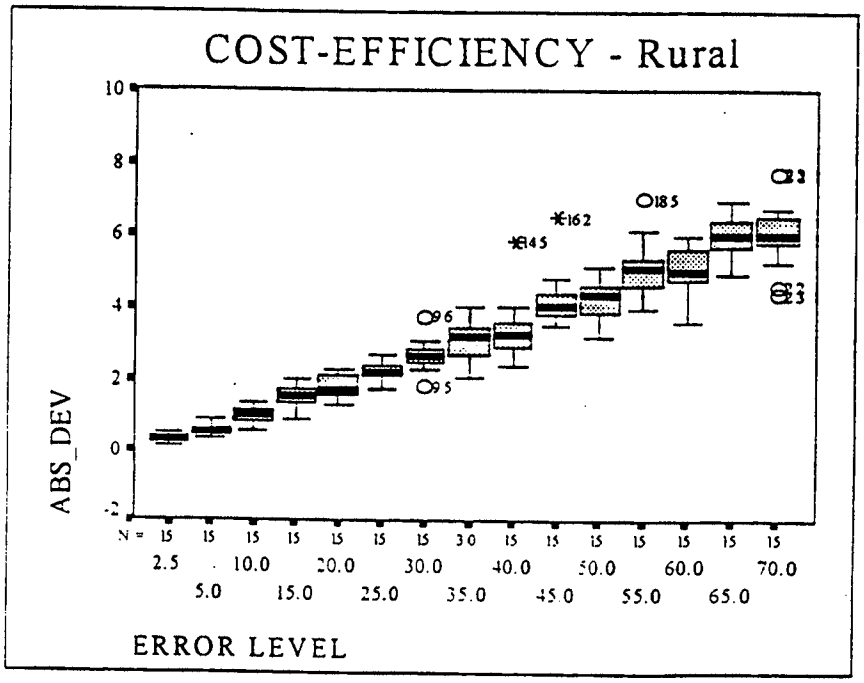
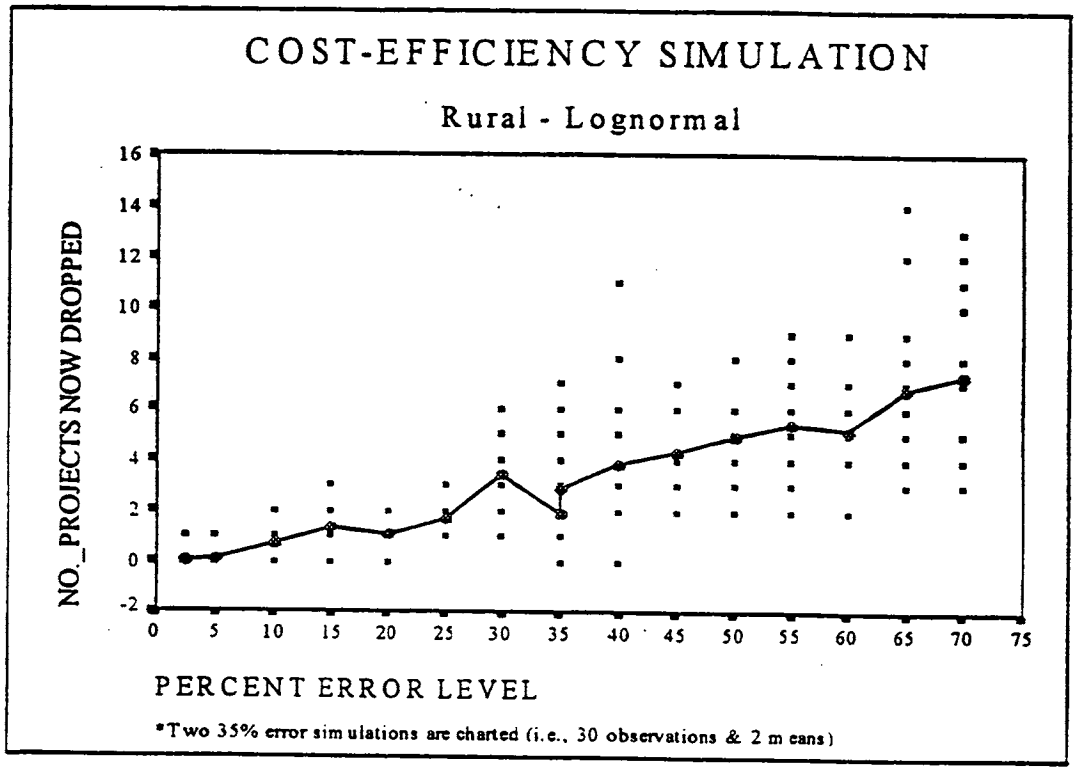


Figure I-1. Cost-efficiency Category Results



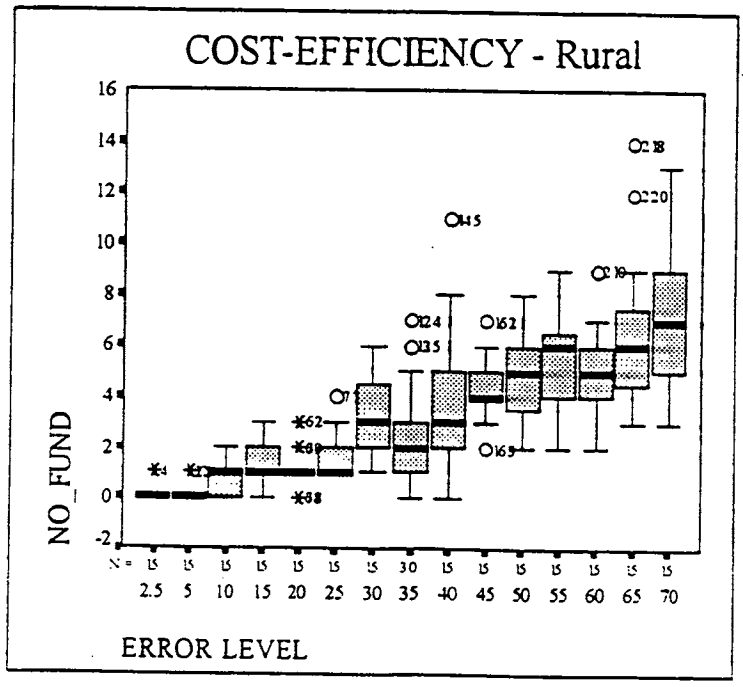
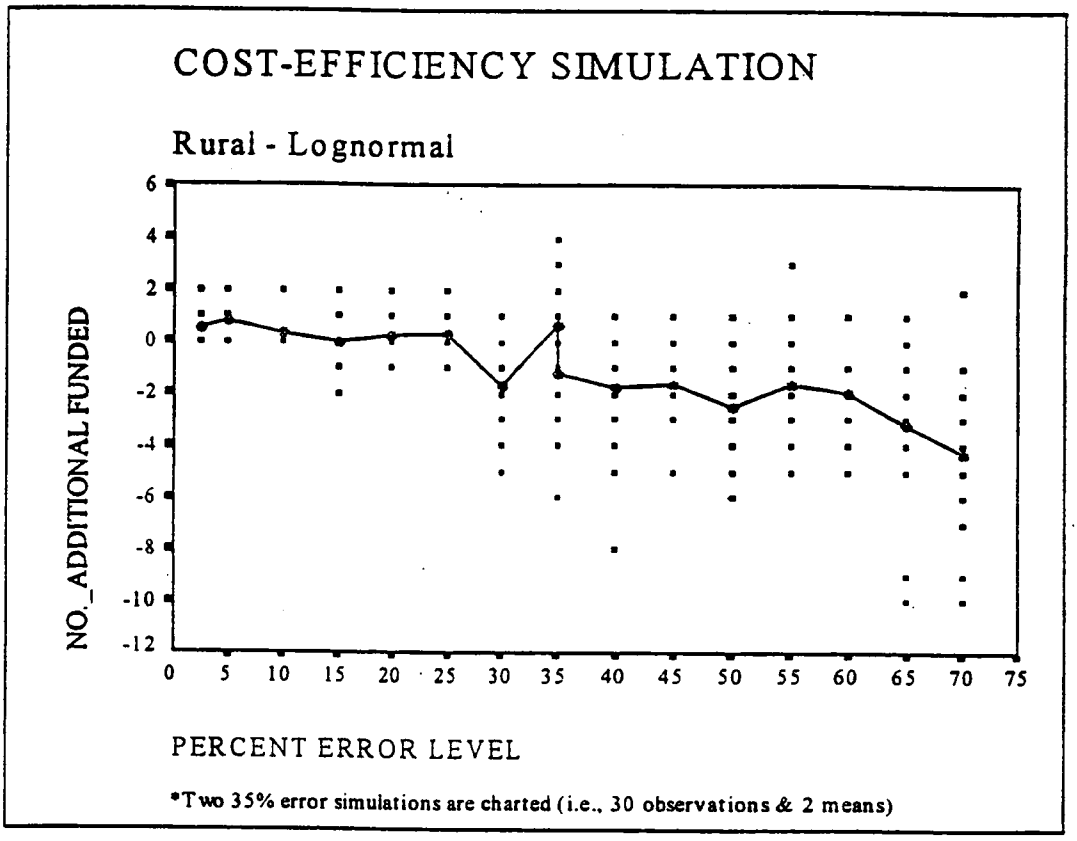


Figure I-1. *Cost-efficiency Category Results (continued)*



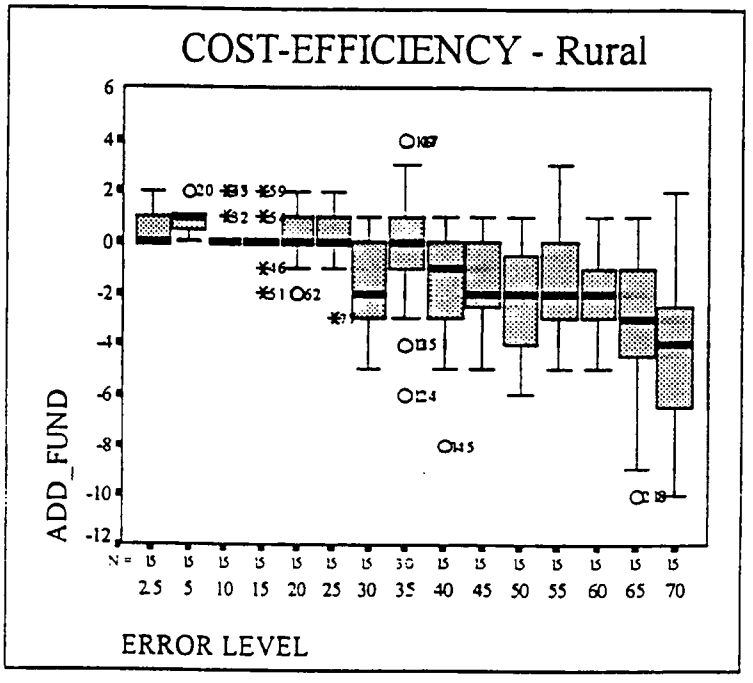
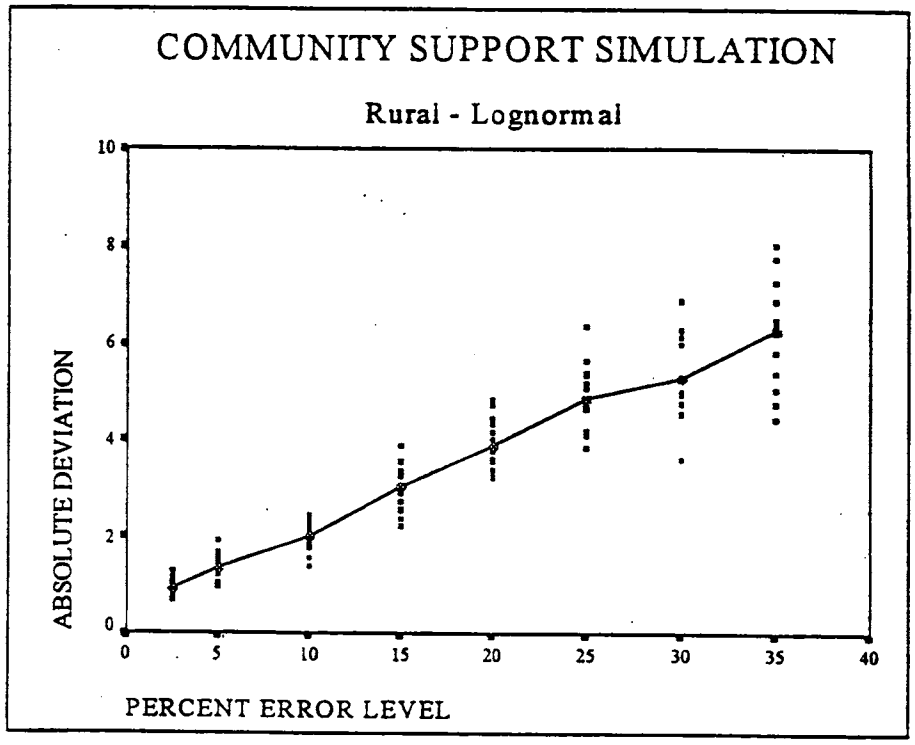


Figure I-1. *Cost-efficiency Category Results (continued)*



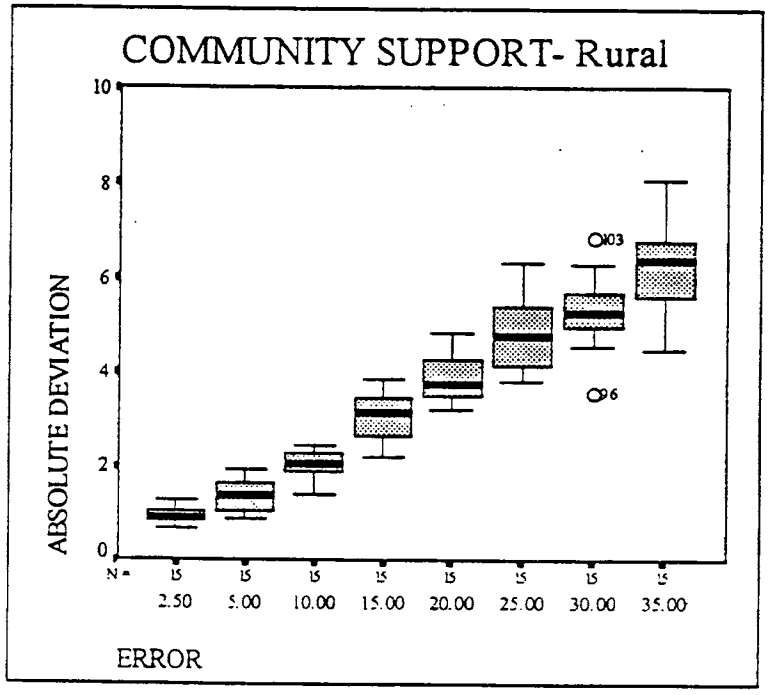
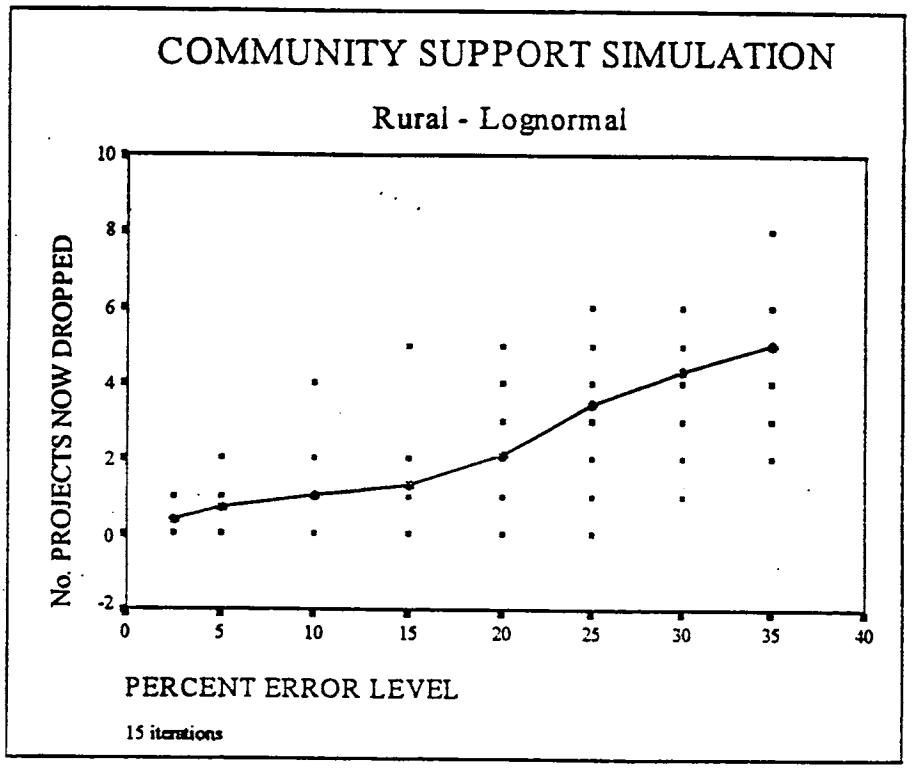


Figure I-2. Community support Category Results



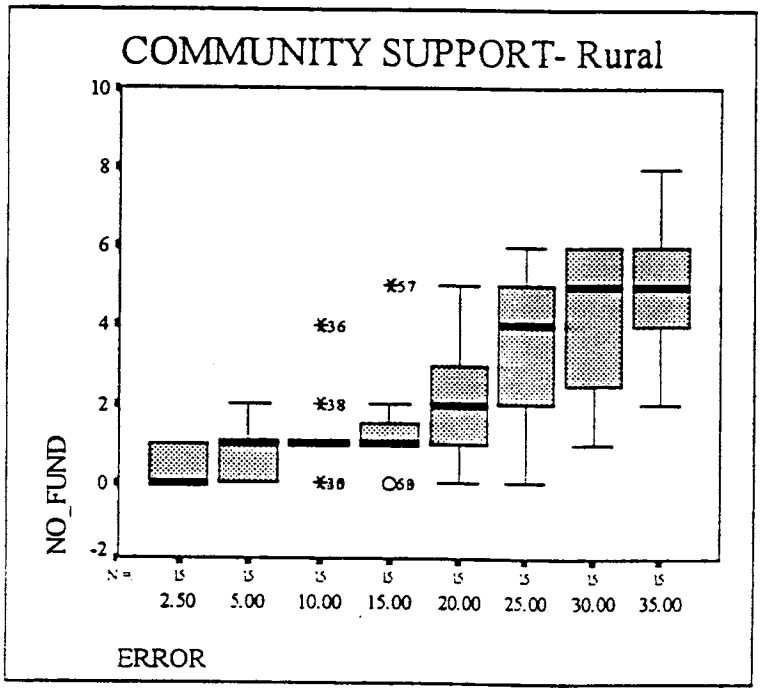
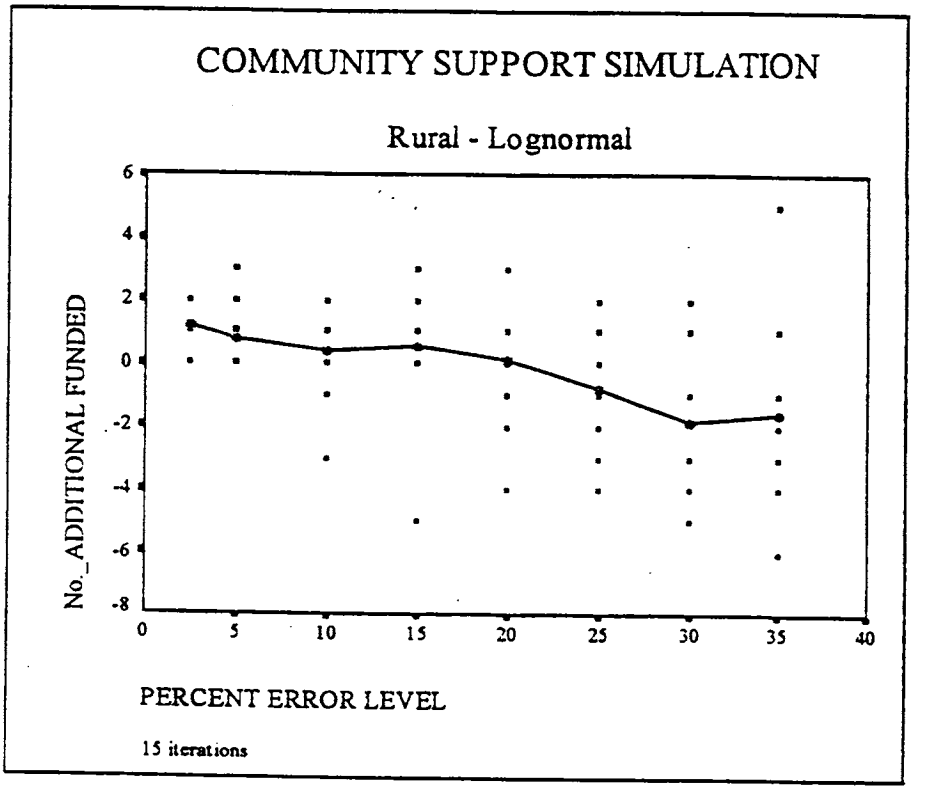


Figure I-2. Community support Category Results (continued)



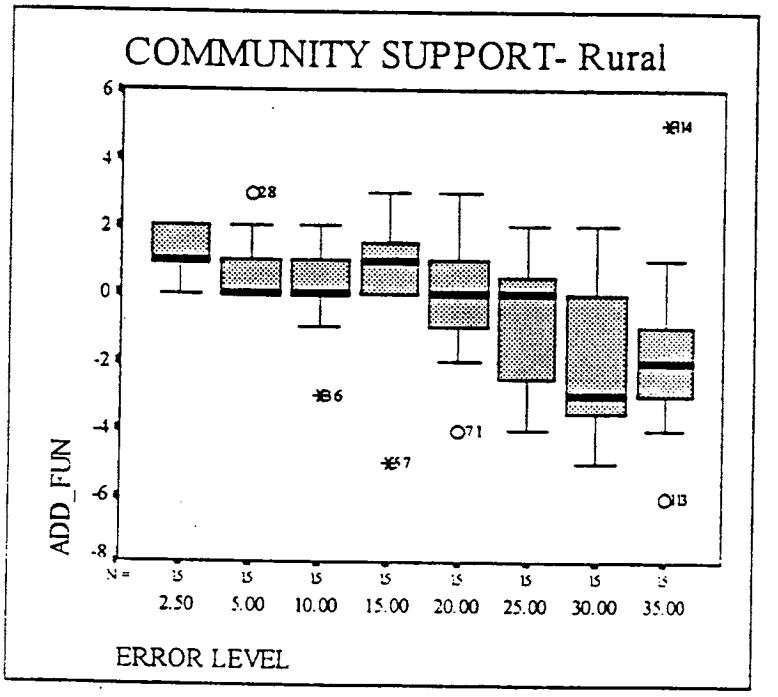
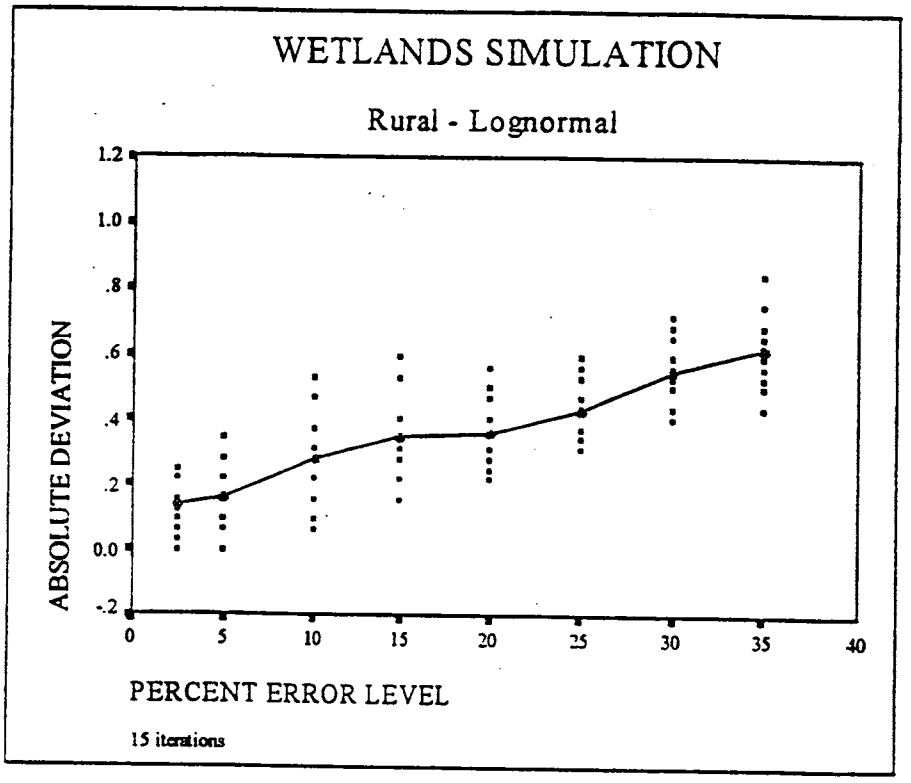


Figure I-2. Community support Category Results (continued)



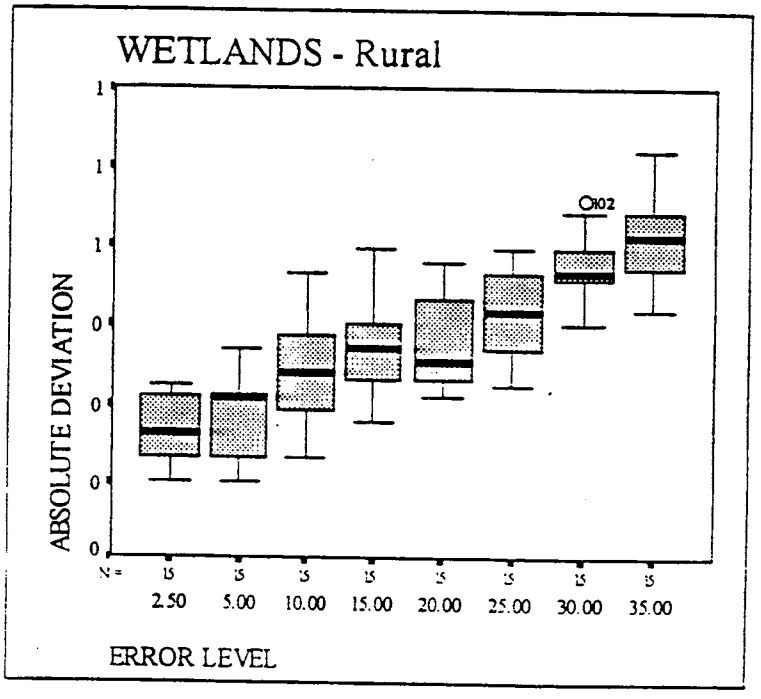
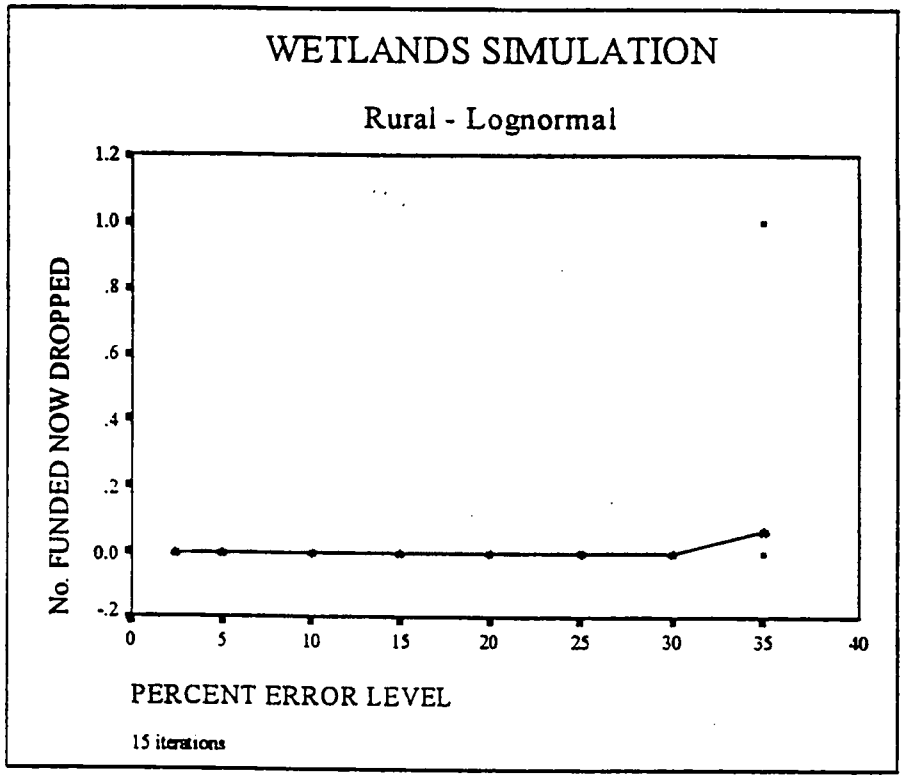


Figure I-3. Wetlands Category Results



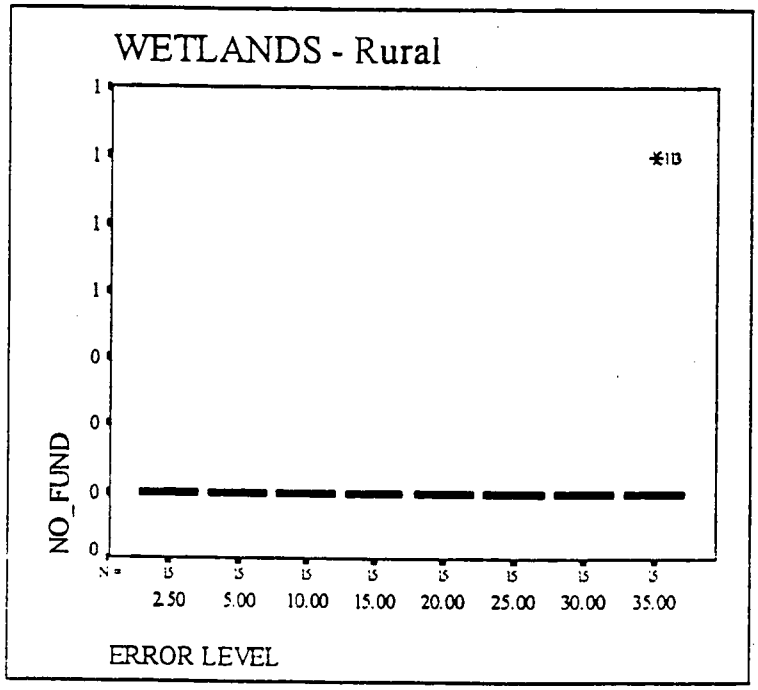
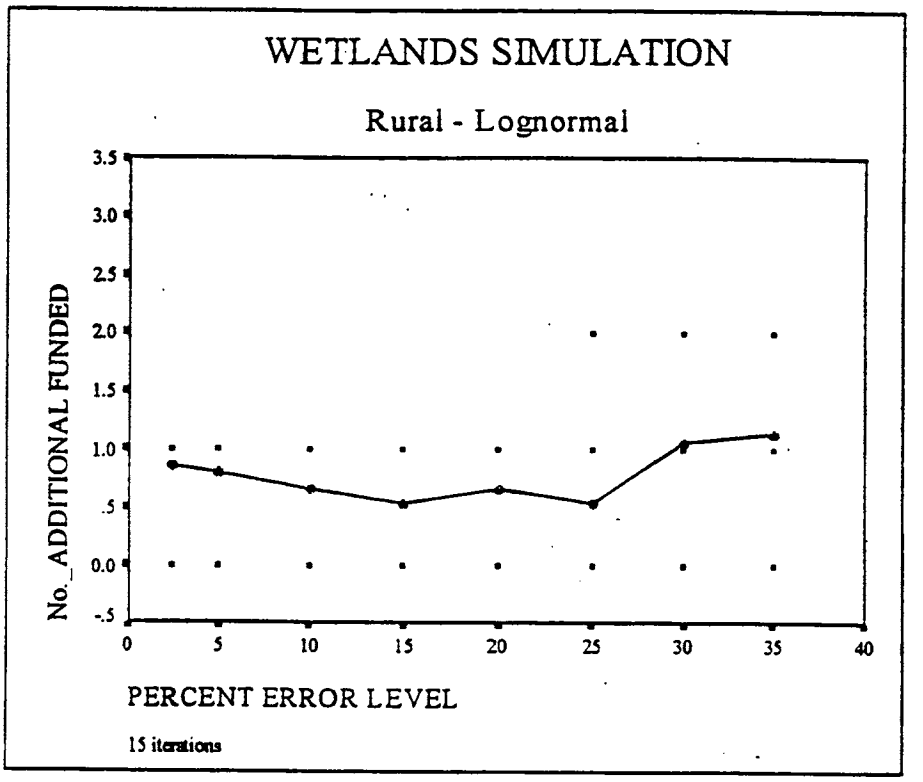


Figure I-3. Wetlands Category Results (continued)



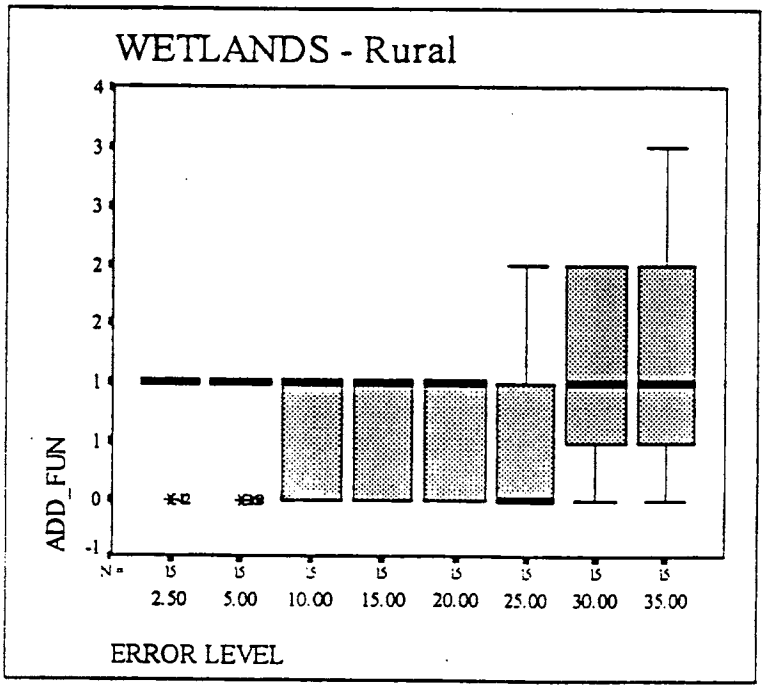
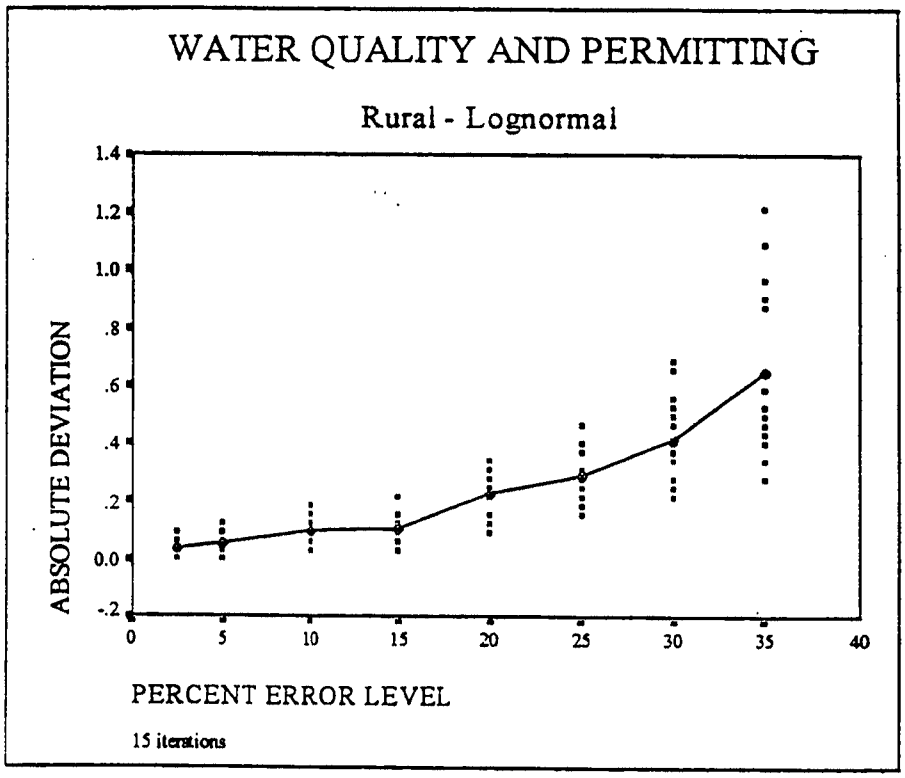


Figure I-3. *Wetlands Category Results (continued)*



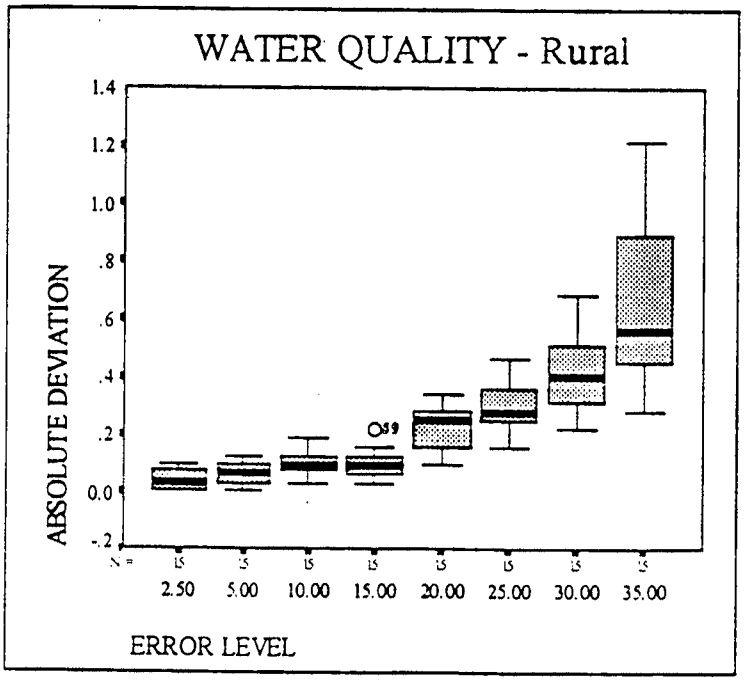
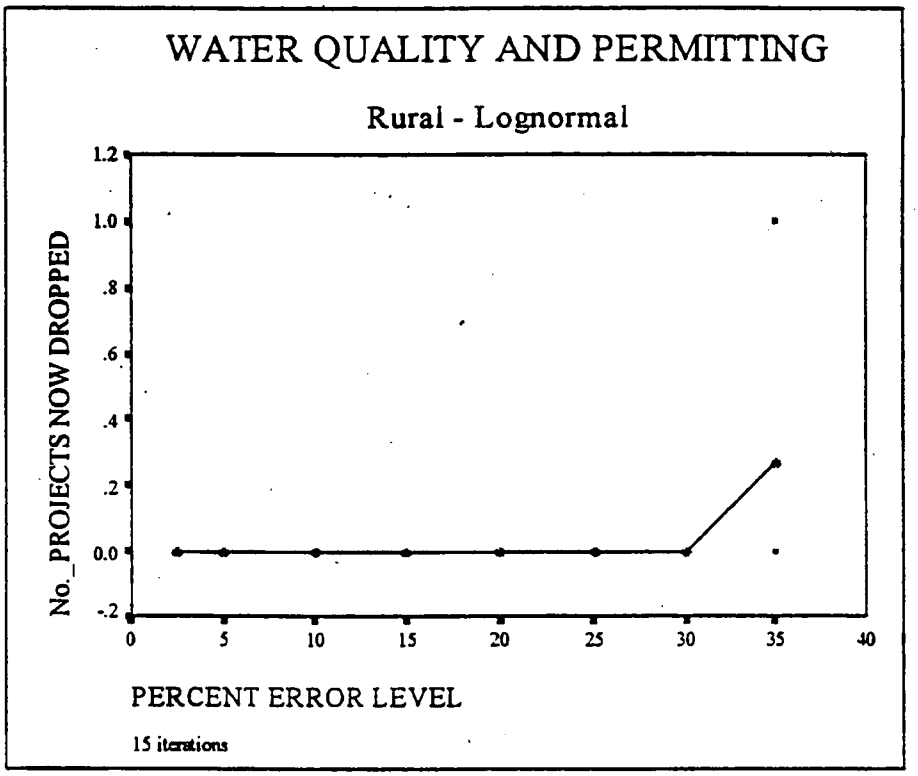


Figure I-4. *Water quality and permitting Category Results*



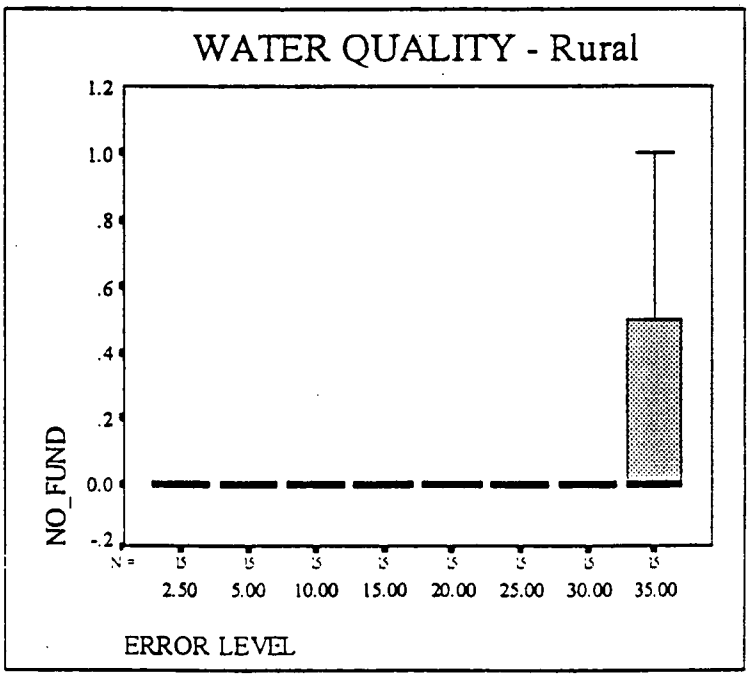
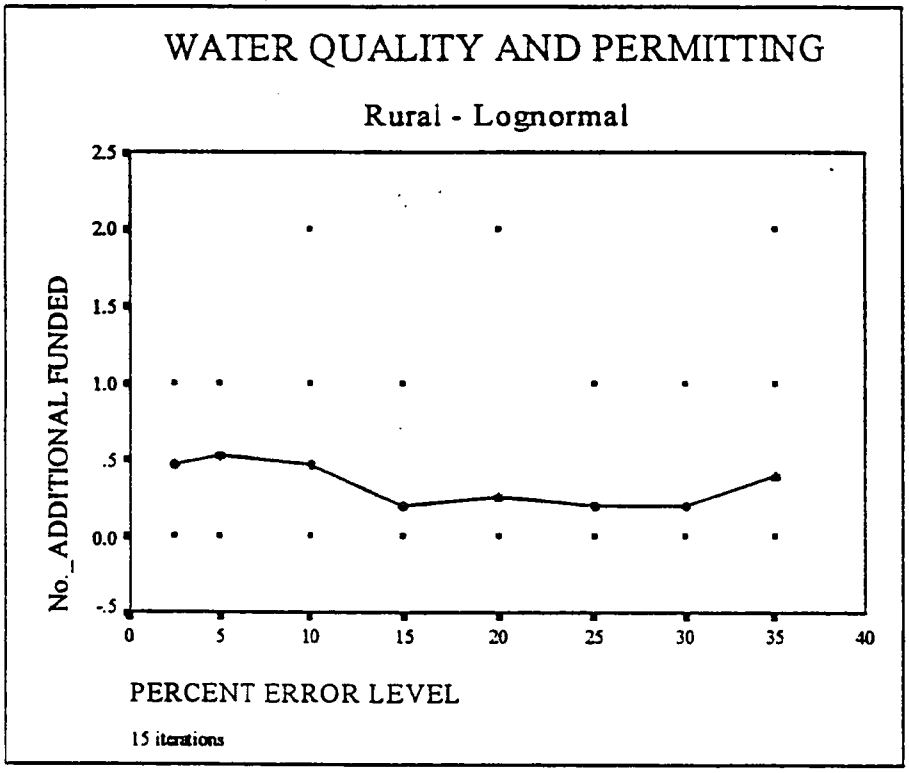


Figure I-4. *Water quality and permitting Category Results (continued)*



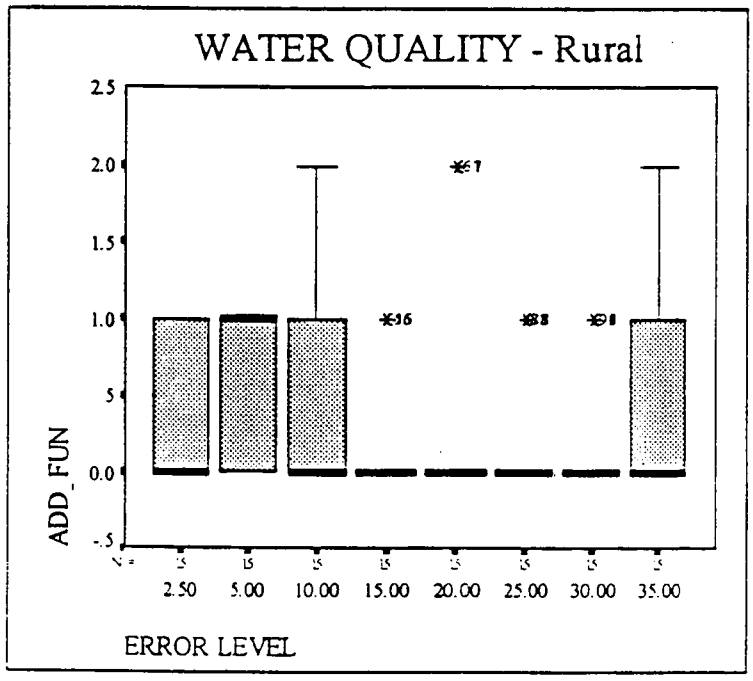
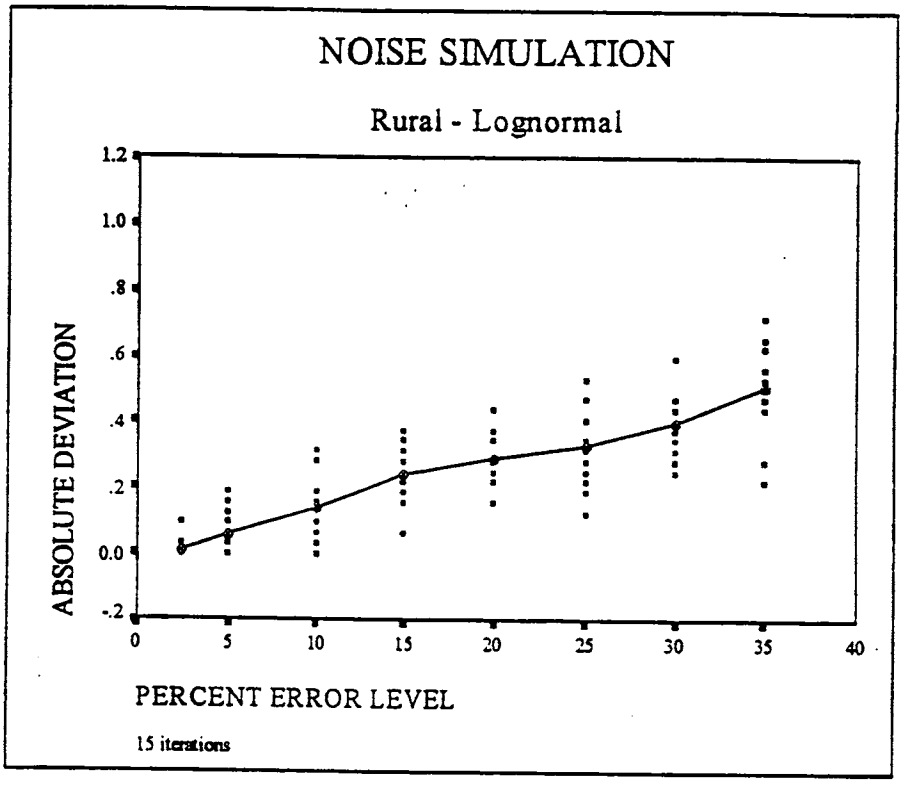


Figure I-4. *Water quality and permitting Category Results (continued)*



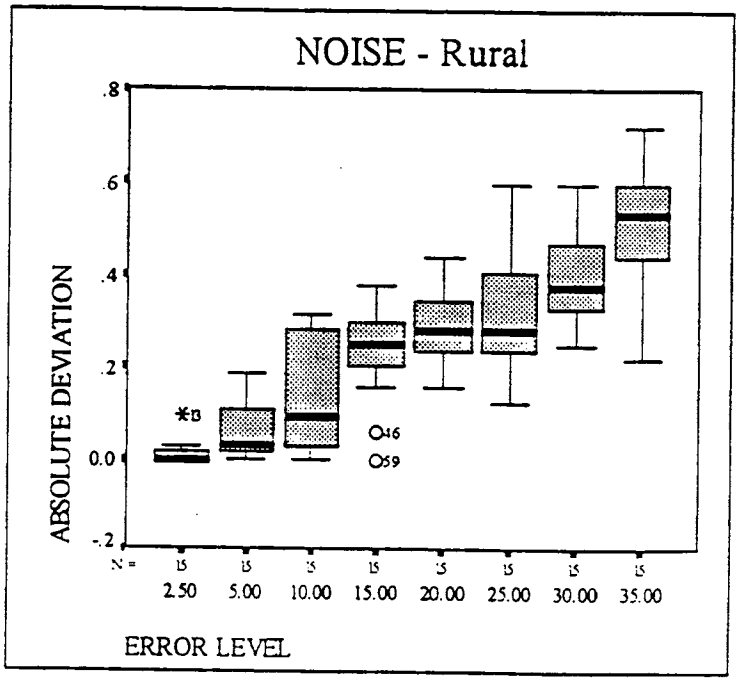
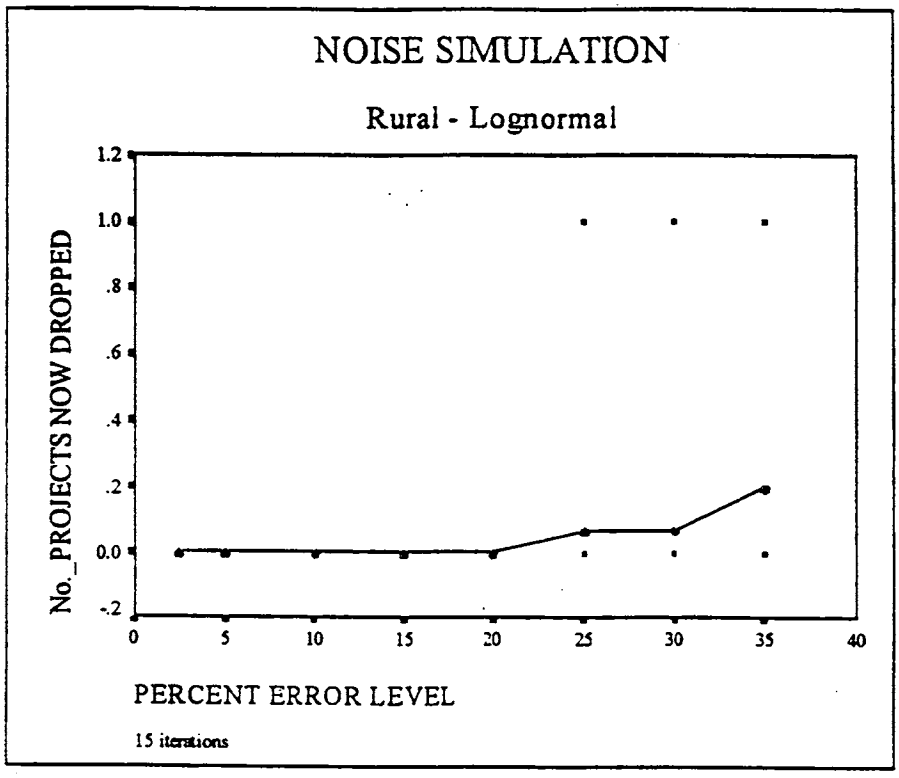


Figure I-5. *Noise Category Results*



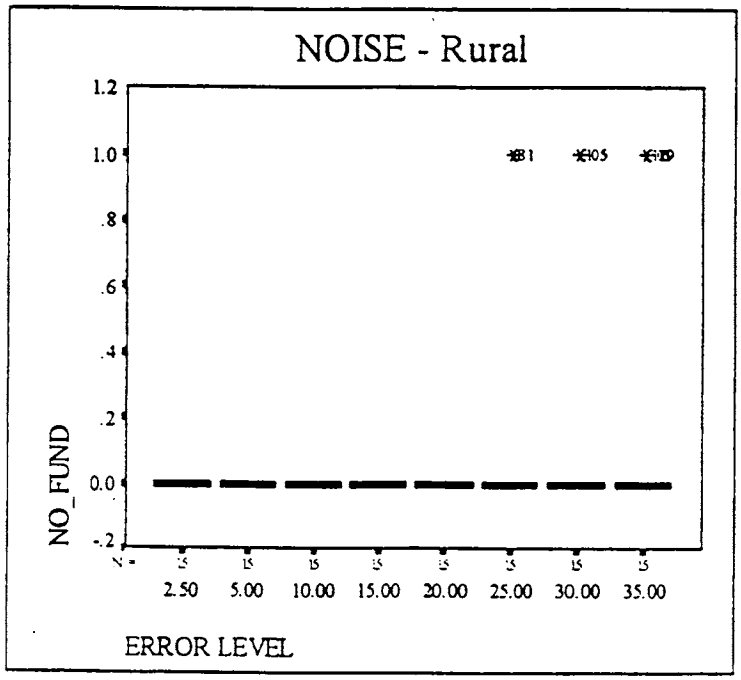
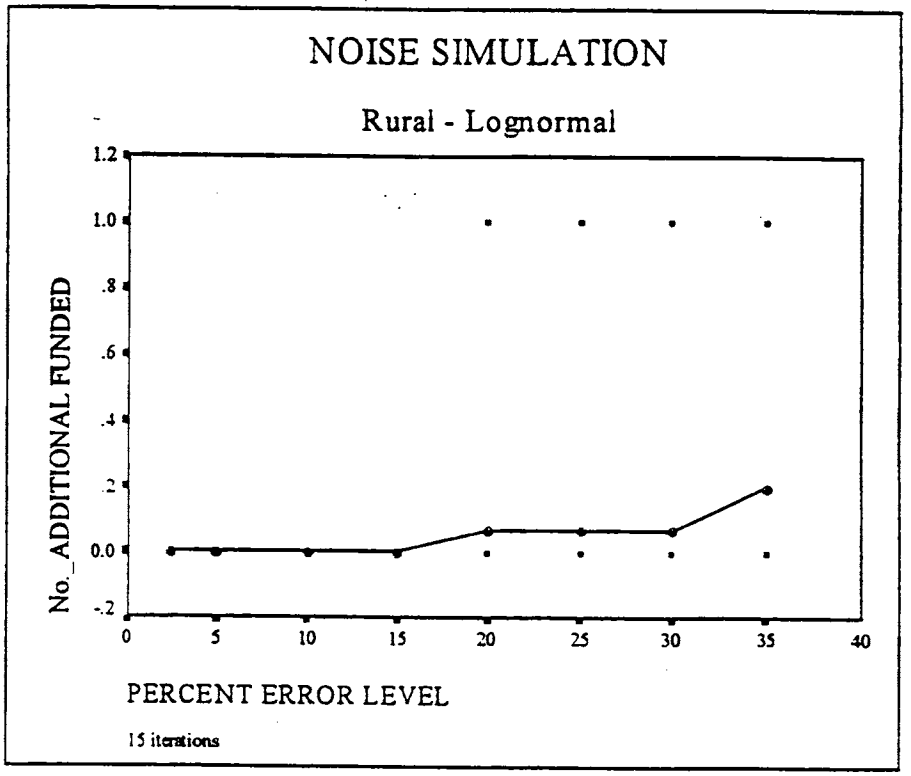


Figure I-5. Noise Category Results (continued)



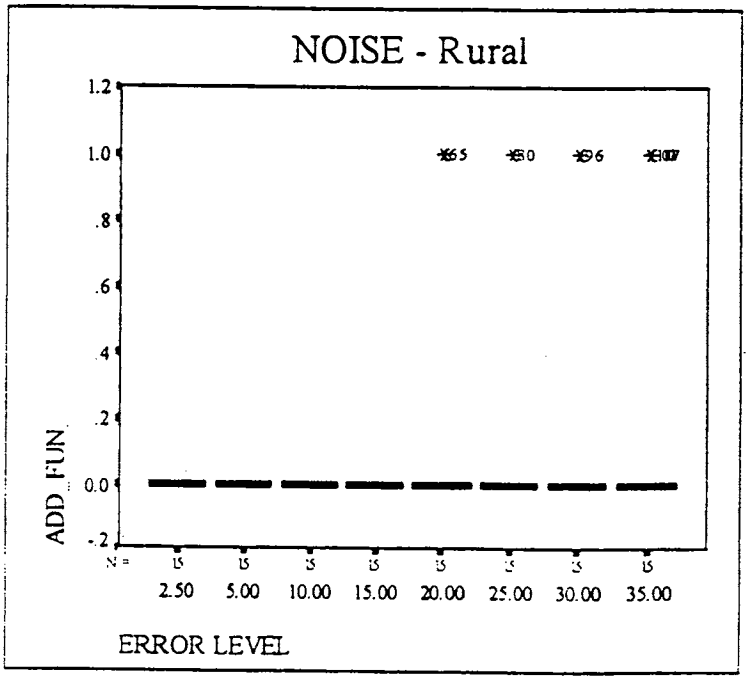
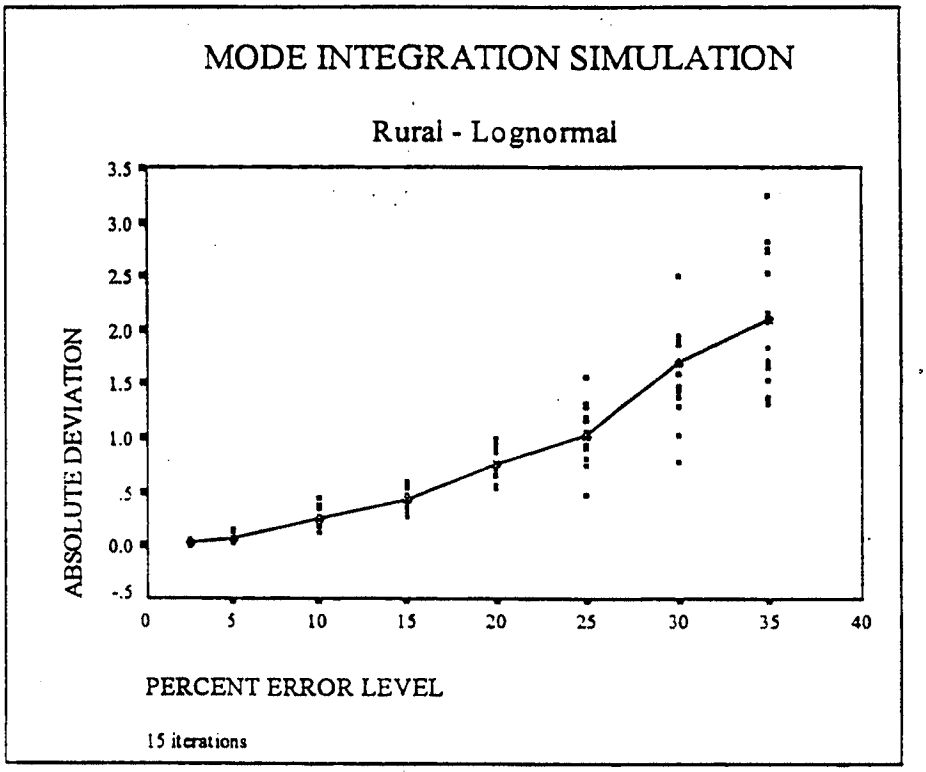


Figure I-5. Noise Category Results (continued)



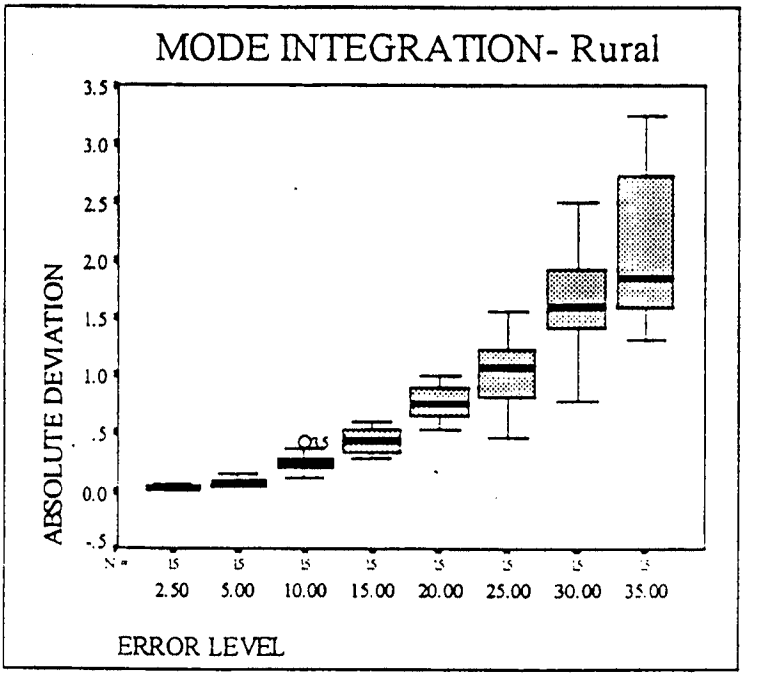
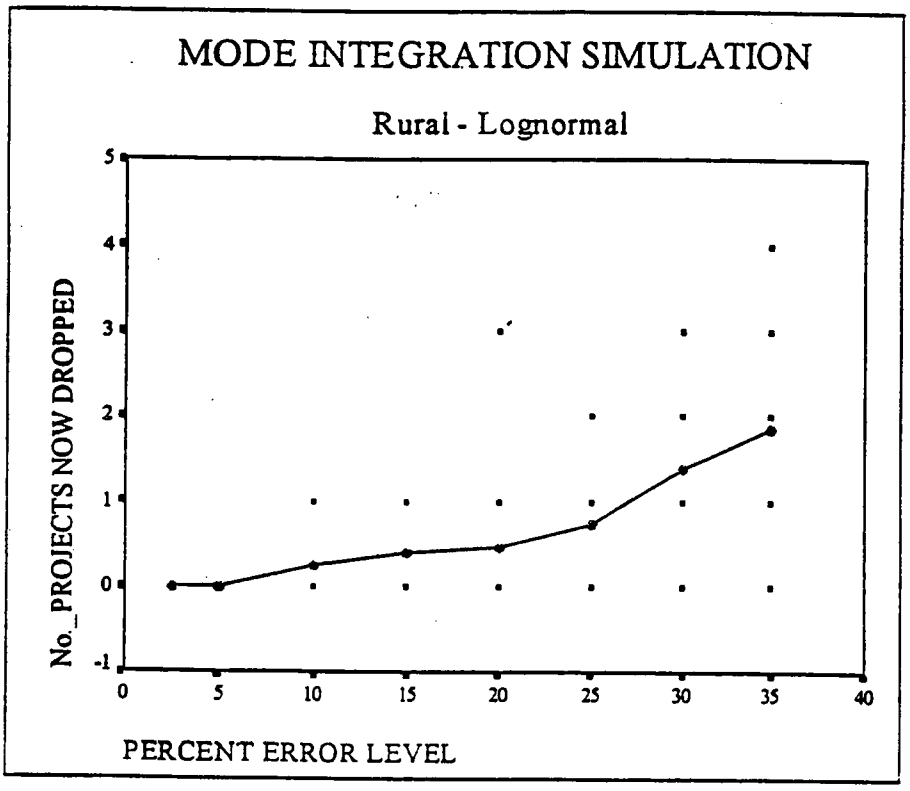


Figure I-6. Mode integration Category Results



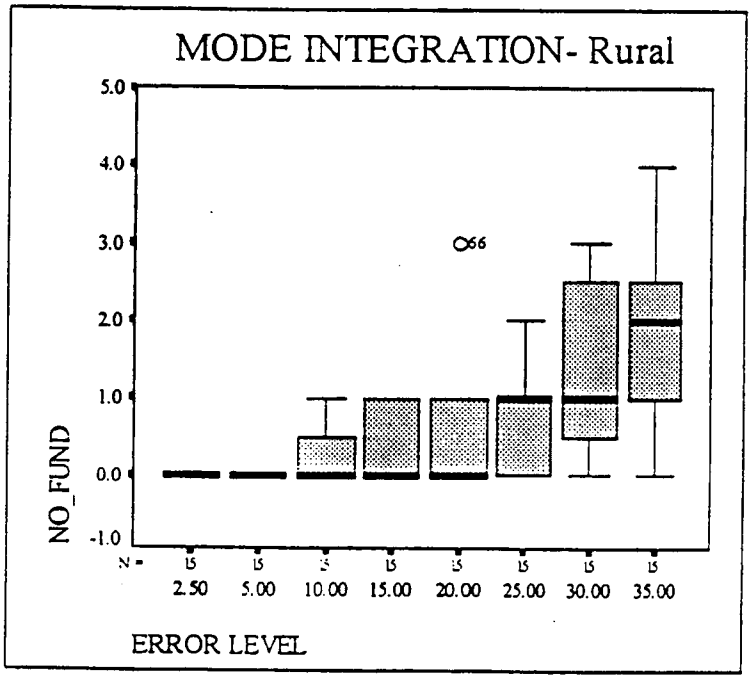
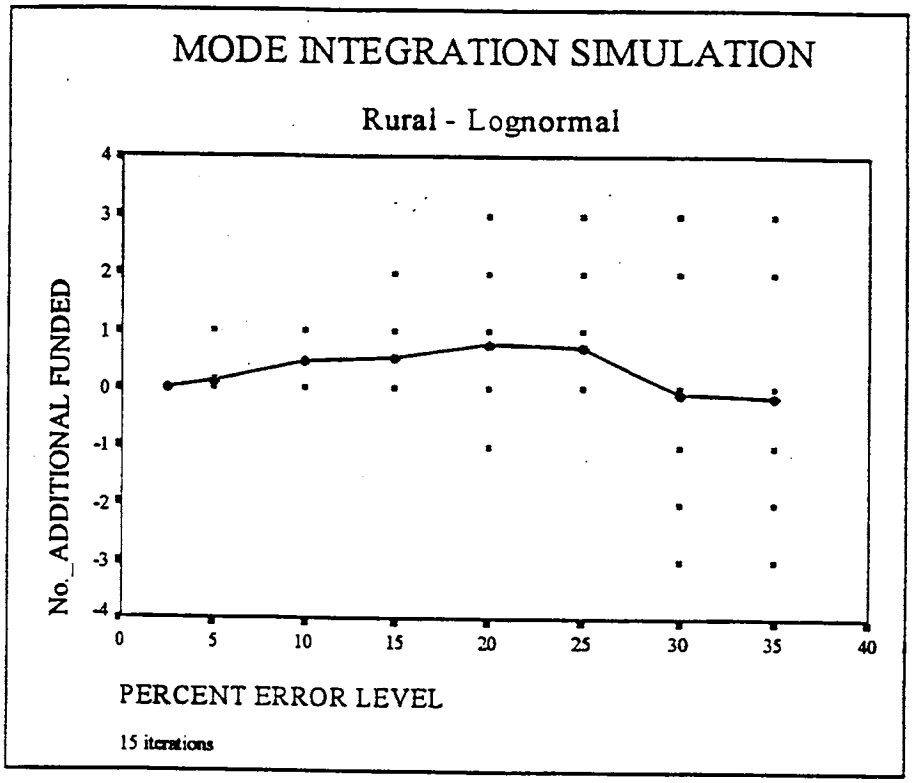


Figure I-6. Mode integration Category Results (continued)



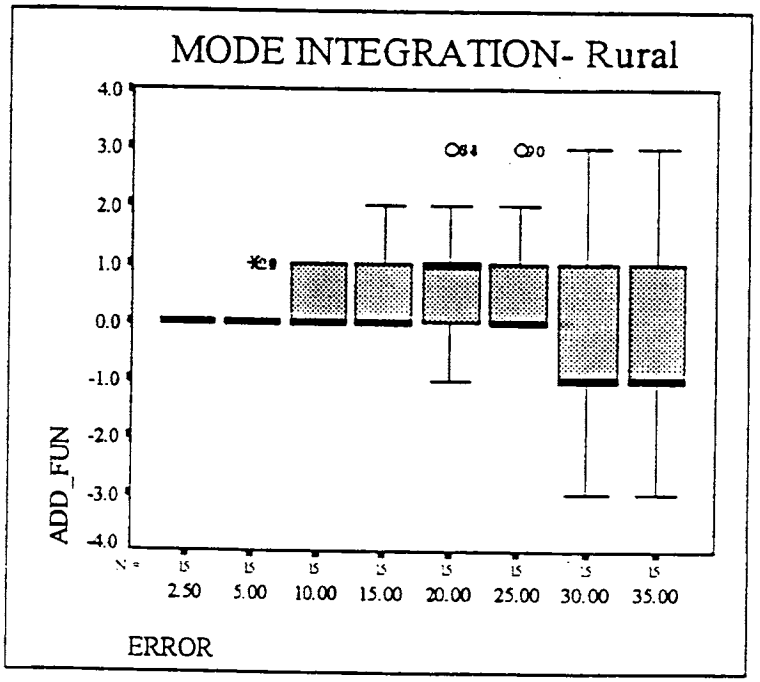
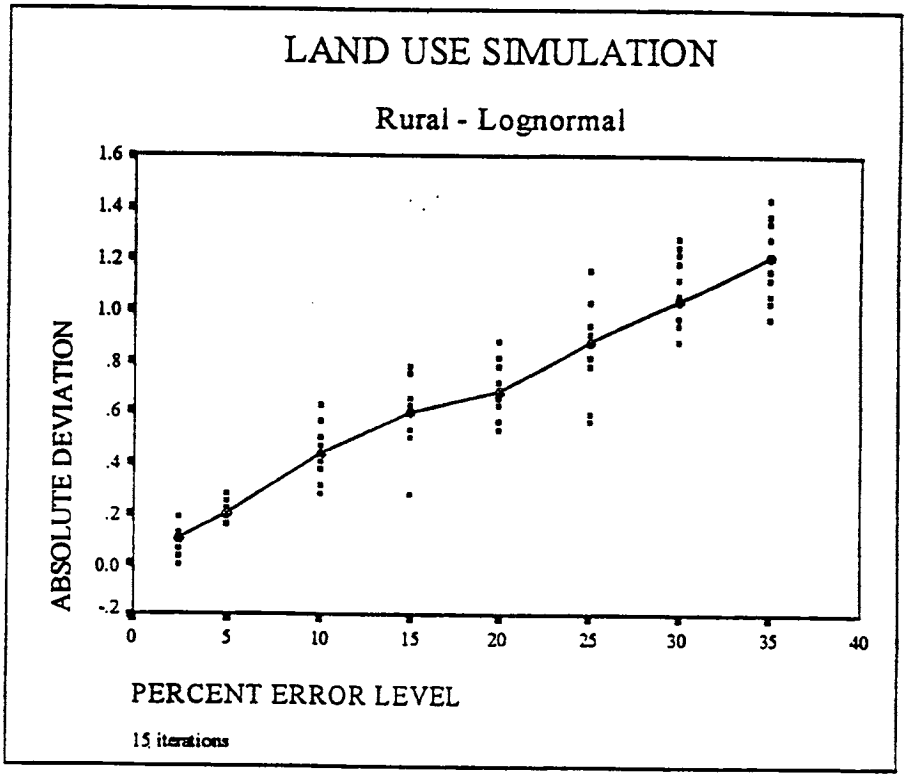


Figure I-6. Mode integration Category Results (continued)



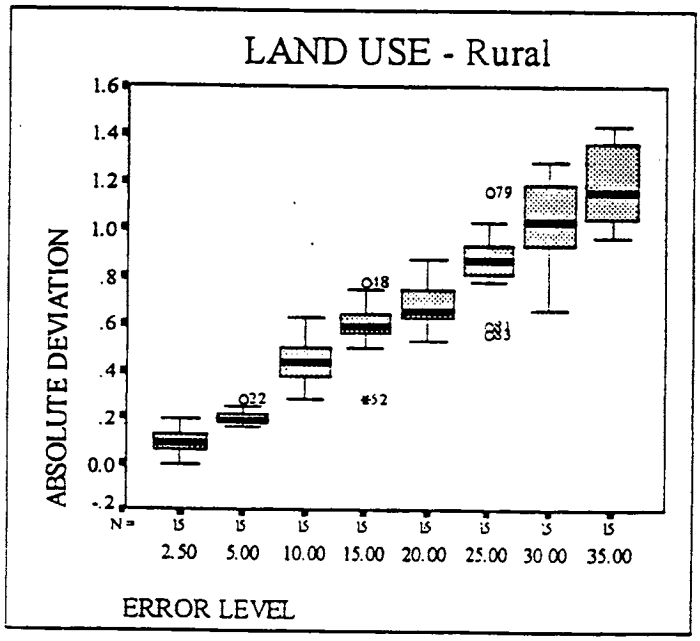
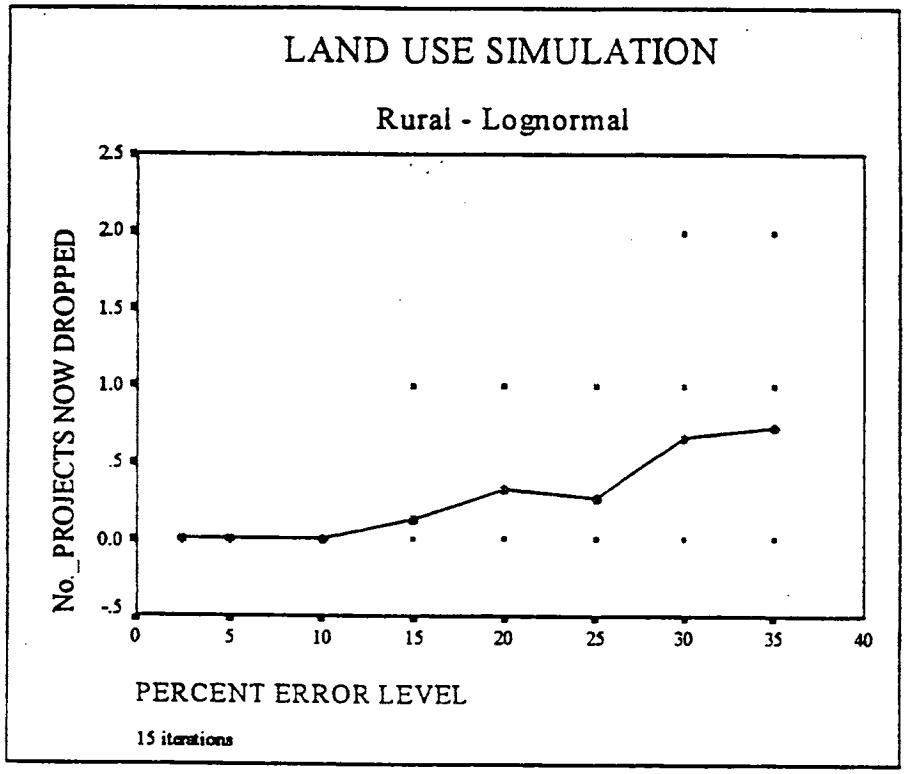


Figure I-7. Land use Category Results



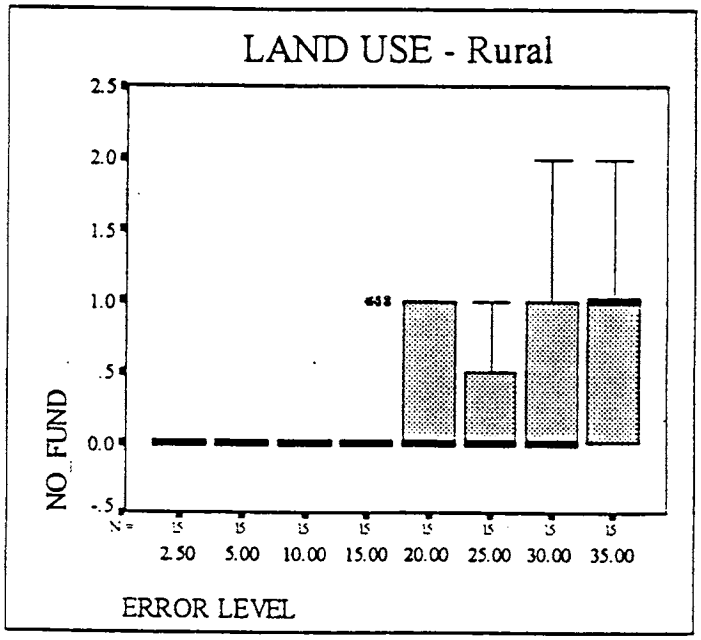
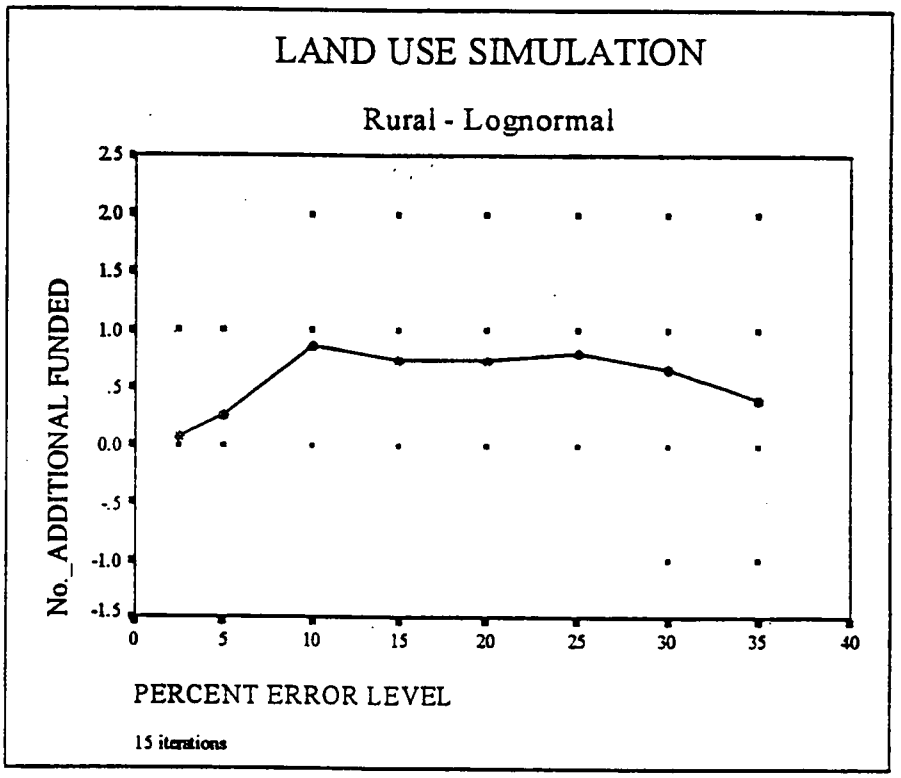


Figure I-7. Land use Category Results (continued)



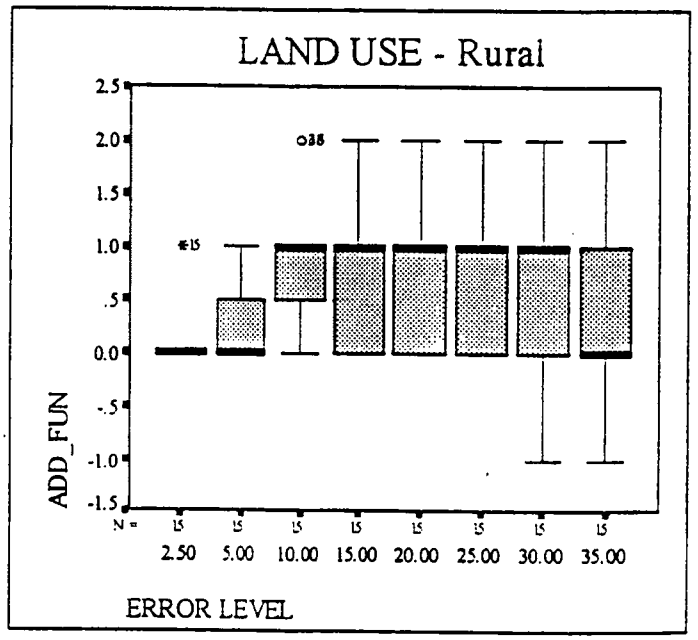


Figure I-7. Land use Category Results (continued)

APPENDIX I. (CONTINUED)

SUMMARY MEASURE BOXPLOTS BY PERCENT ERROR LEVEL

HOW TO READ BOXPLOTS

*	= Extremes > 3 box lengths from 75th percentile
o	= Outliers > 1.5 box lengths from 75th percentile.
___	= Largest observation that is not an outlier.
|	
□	= Box (median is denoted by heavy black line).
___	= Smallest observation that is not an outlier.

Figure I-8. Boxplot Symbols

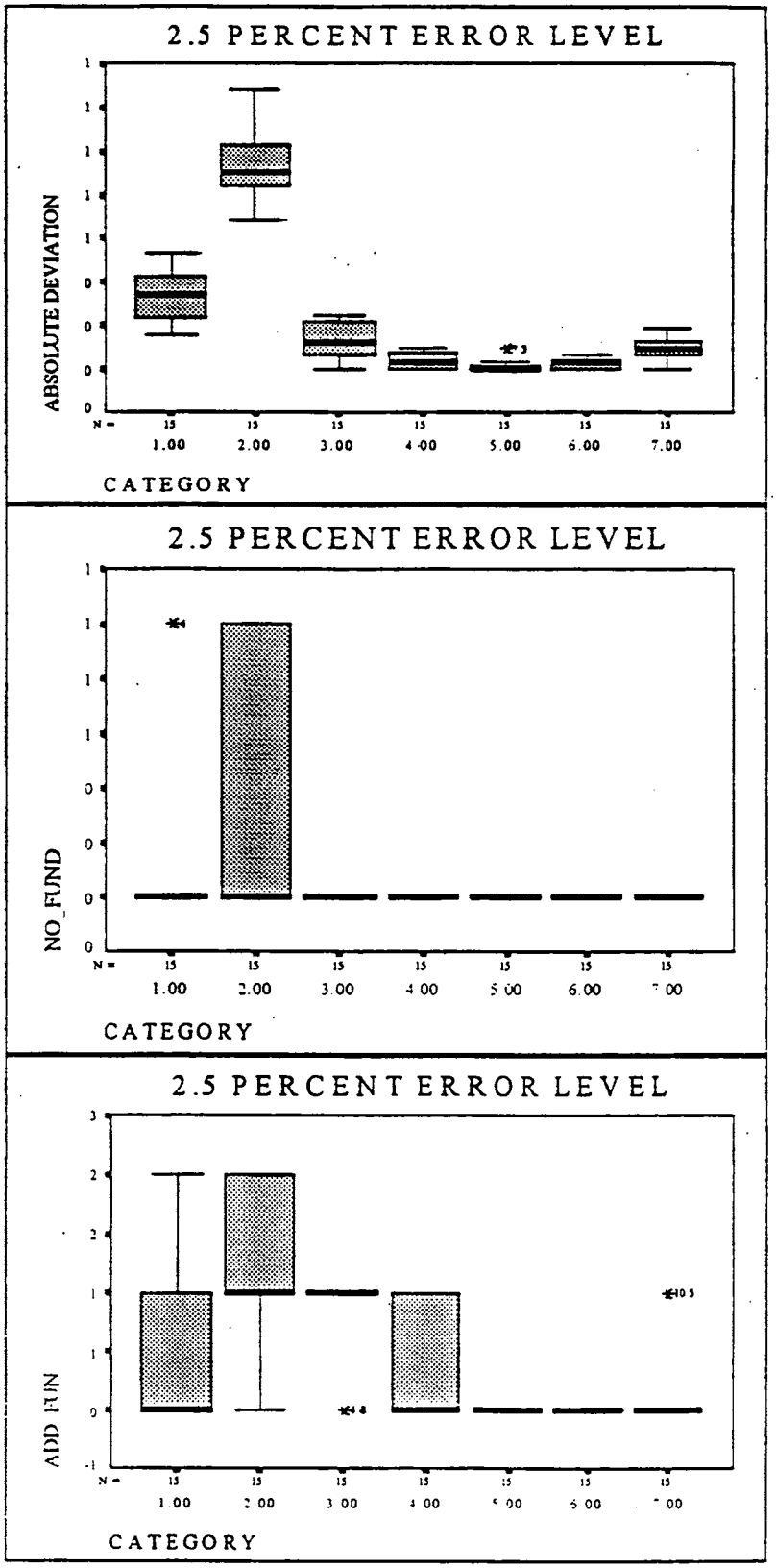


Figure I-9. *Percent Error Results - 2.5*

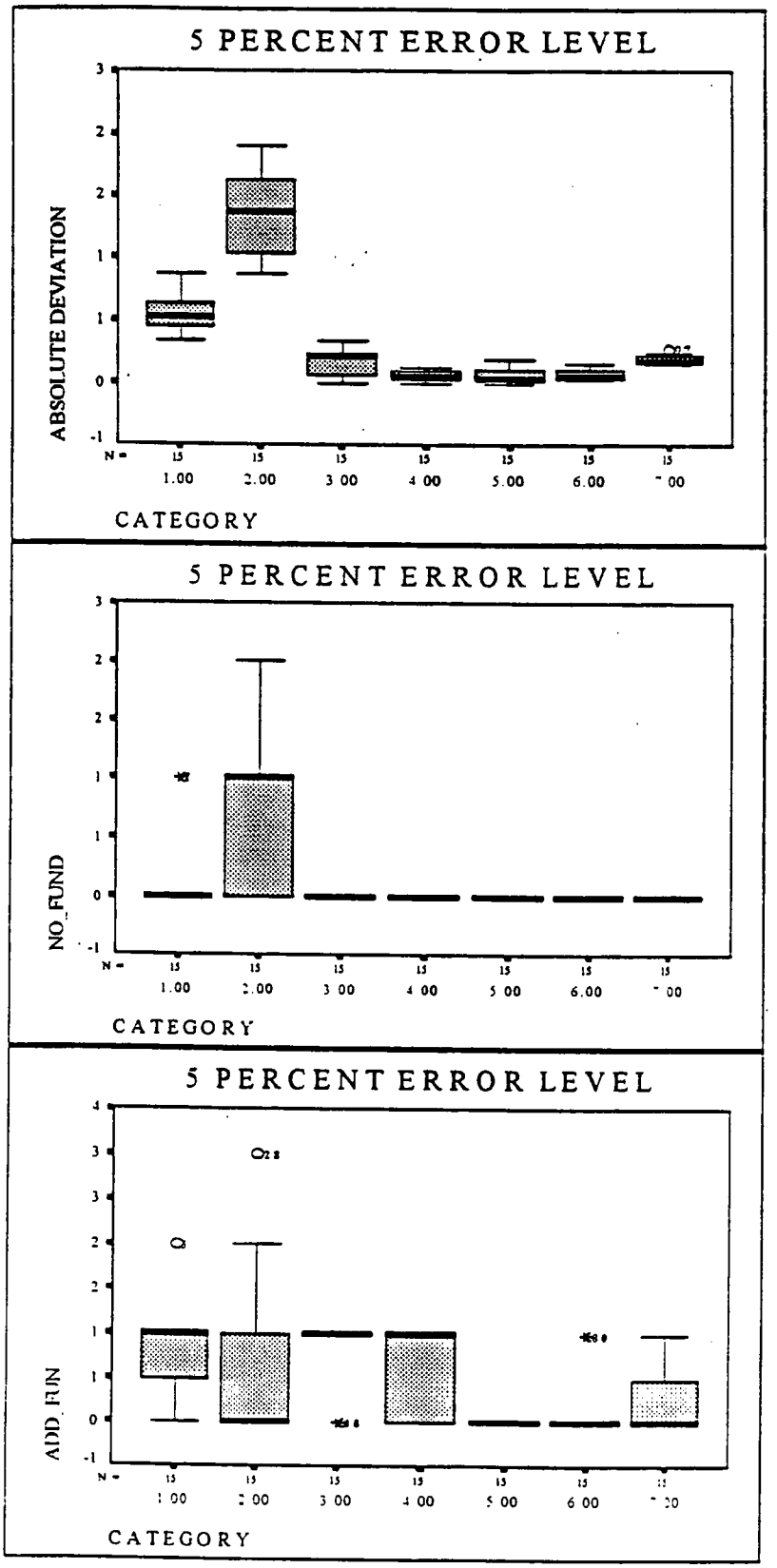


Figure I-10. Percent Error Results - 5.0

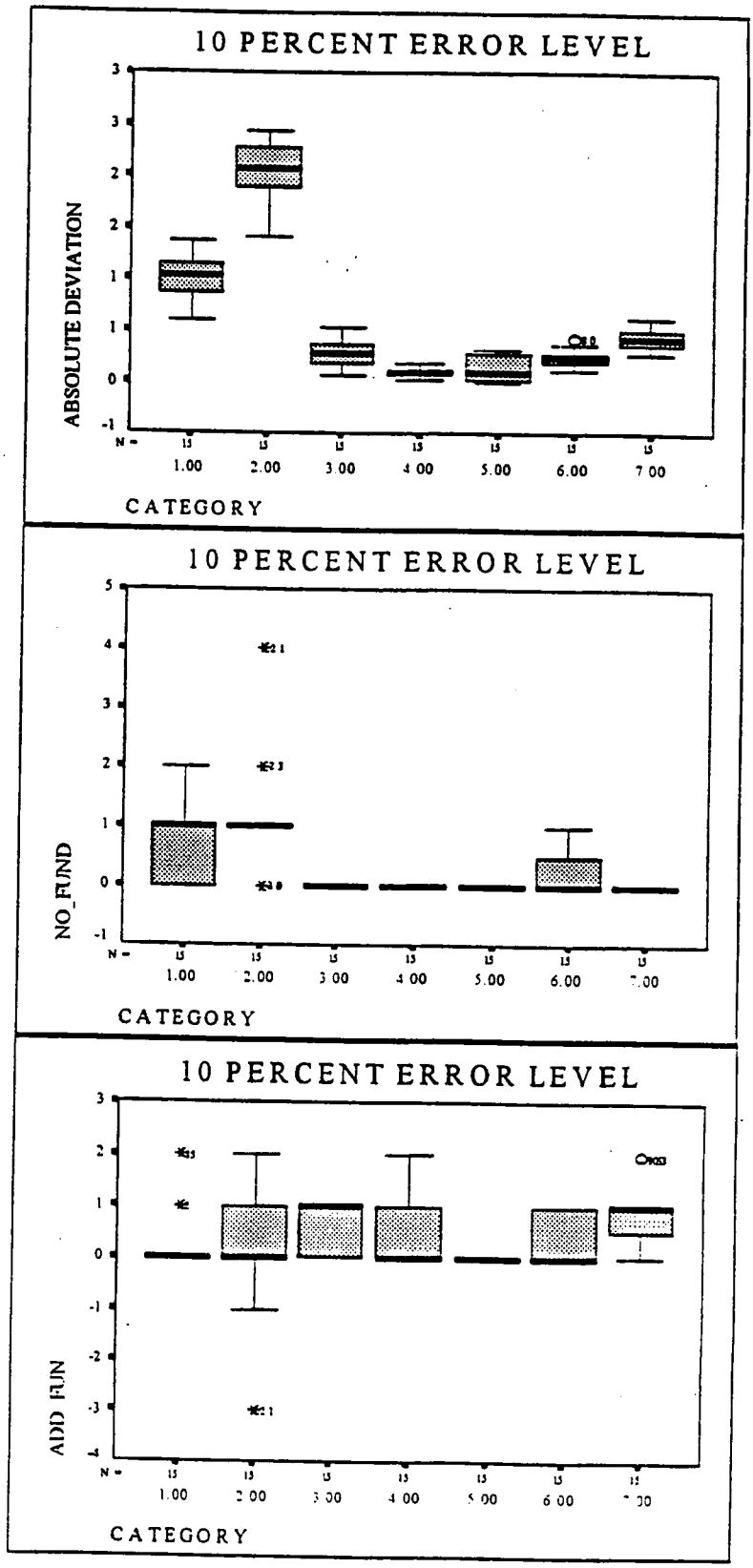


Figure I-11. Percent Error Results - 10

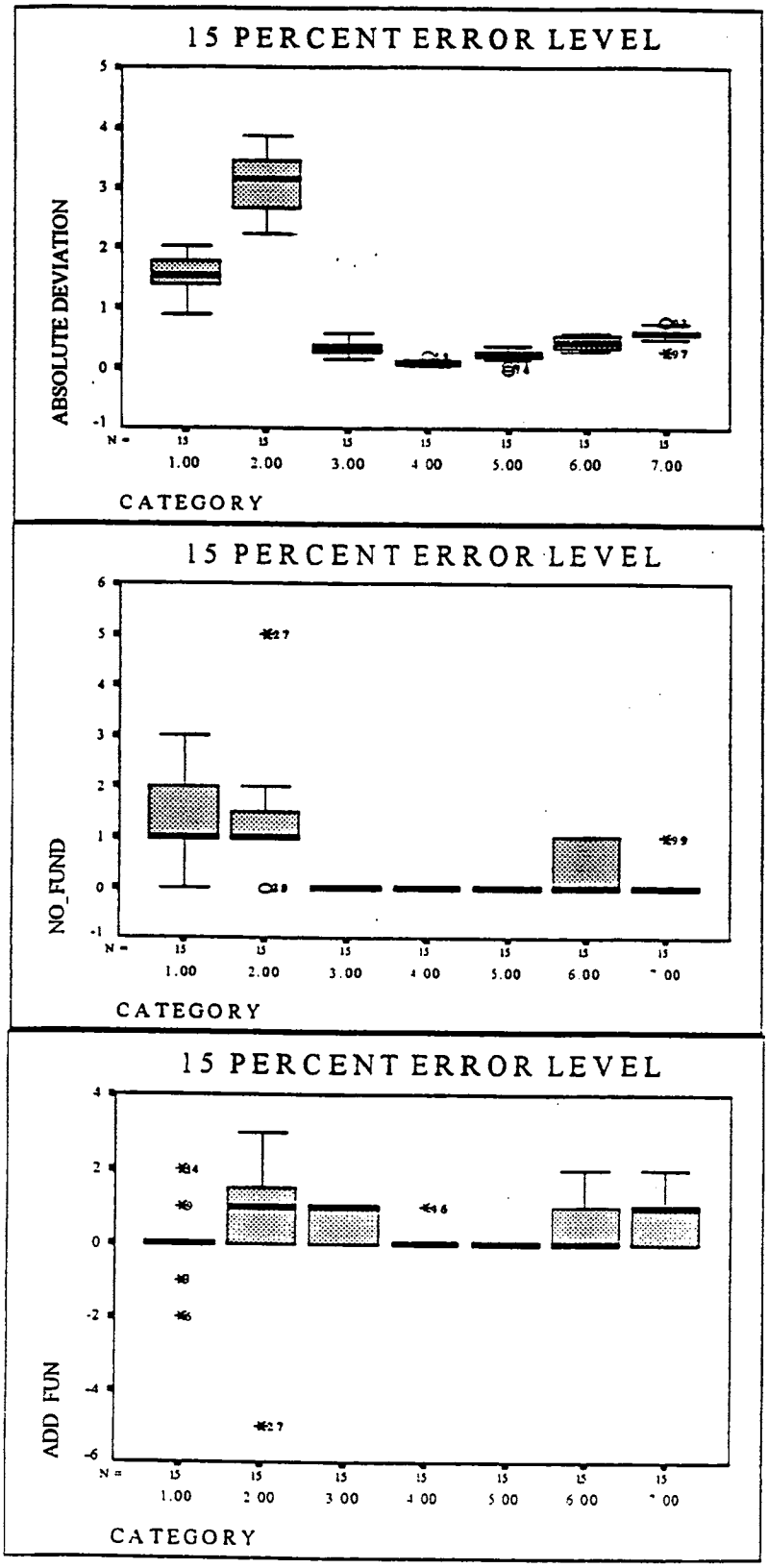


Figure I-12. Percent Error Results - 15

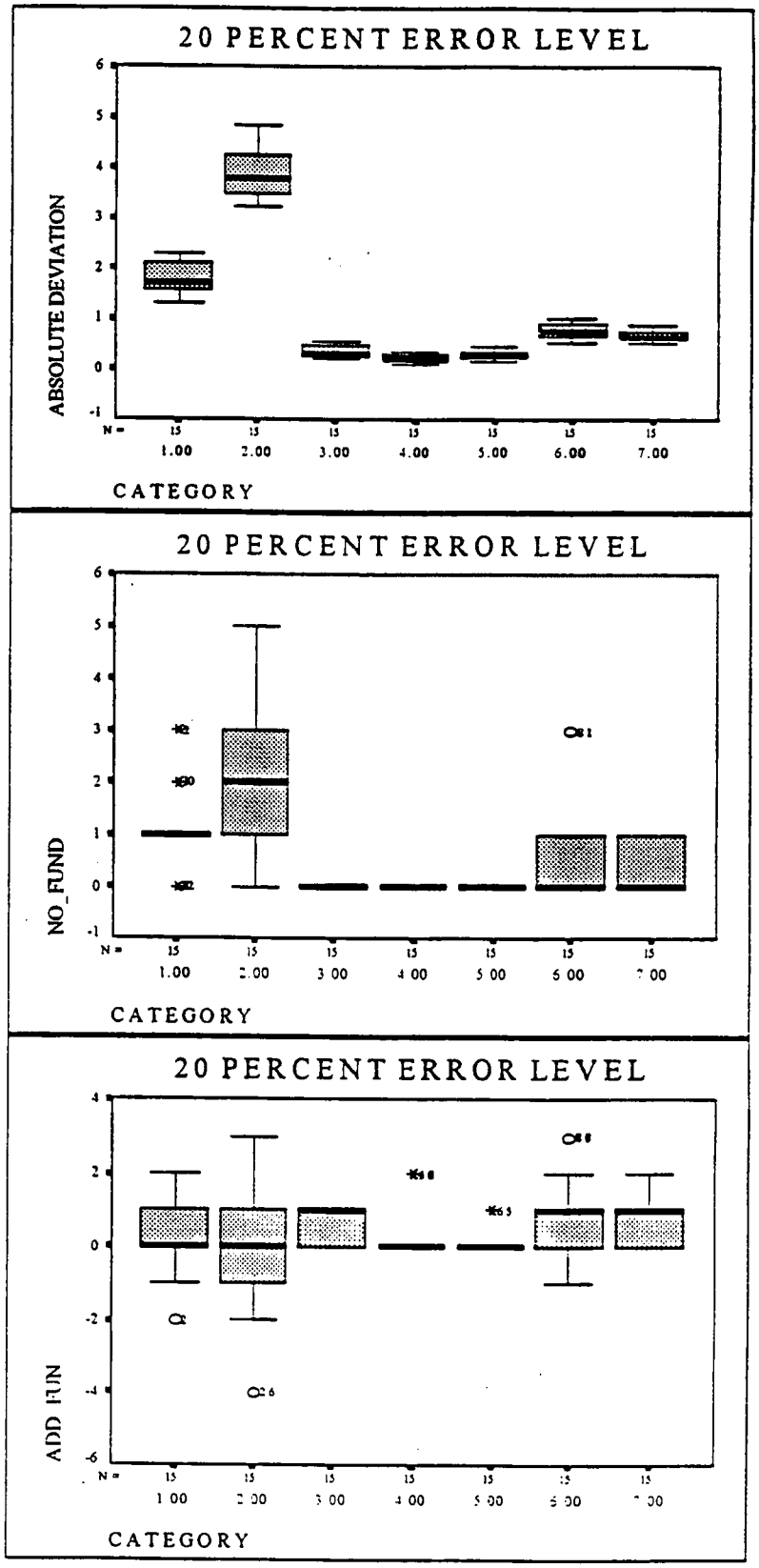


Figure I-13. Percent Error Results - 20

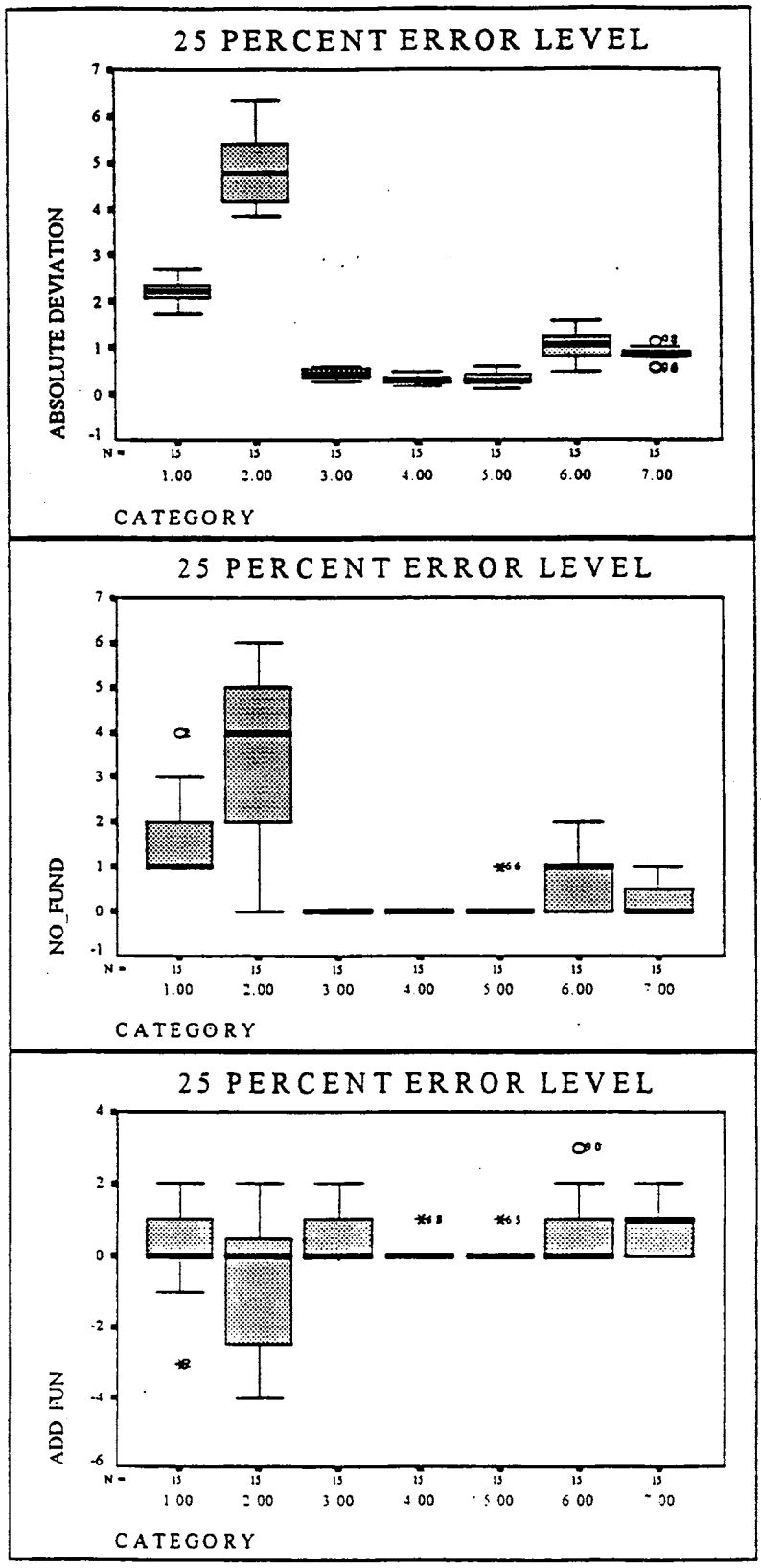


Figure I-14. Percent Error Results - 25

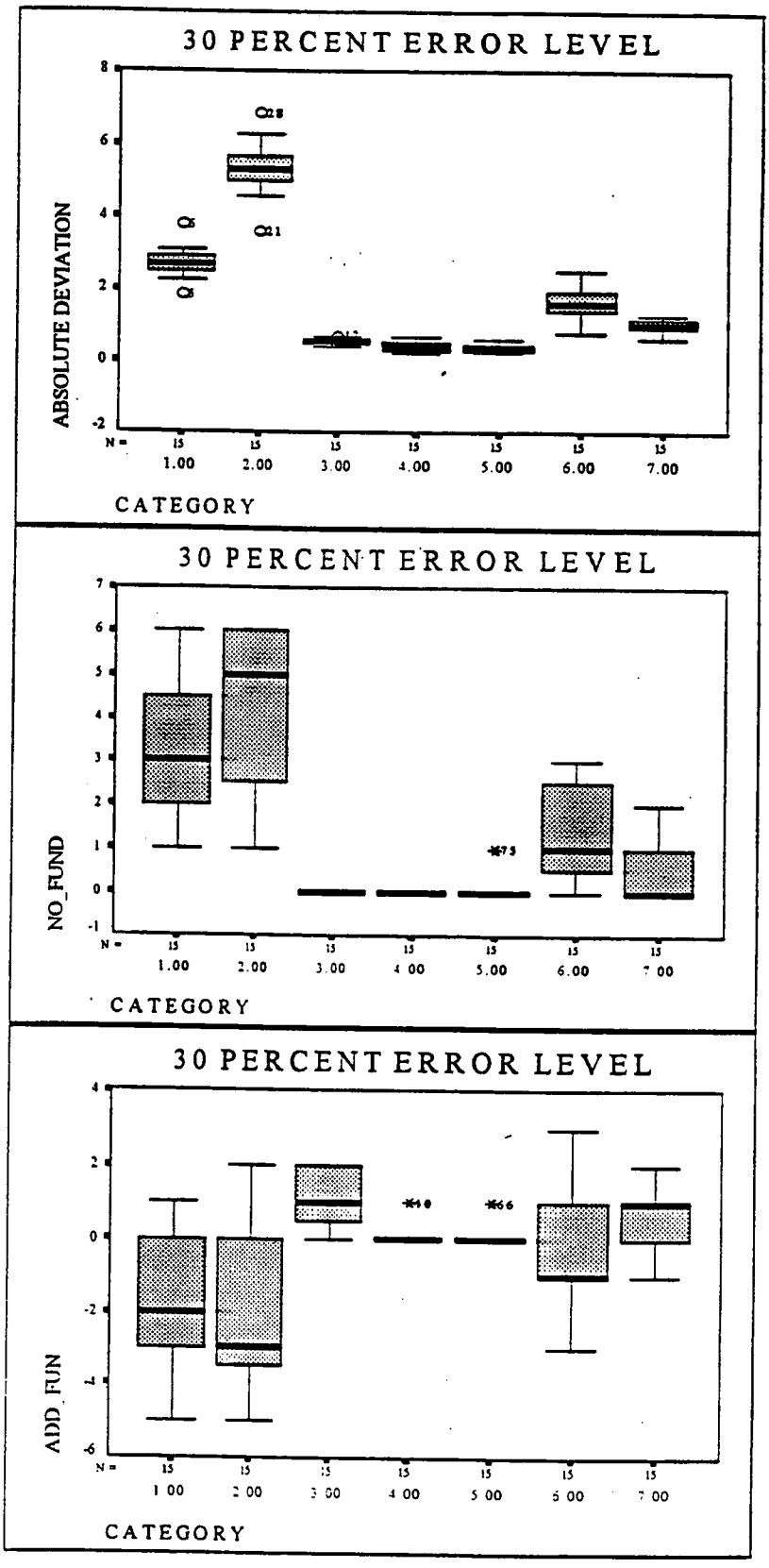


Figure I-15. Percent Error Results - 30

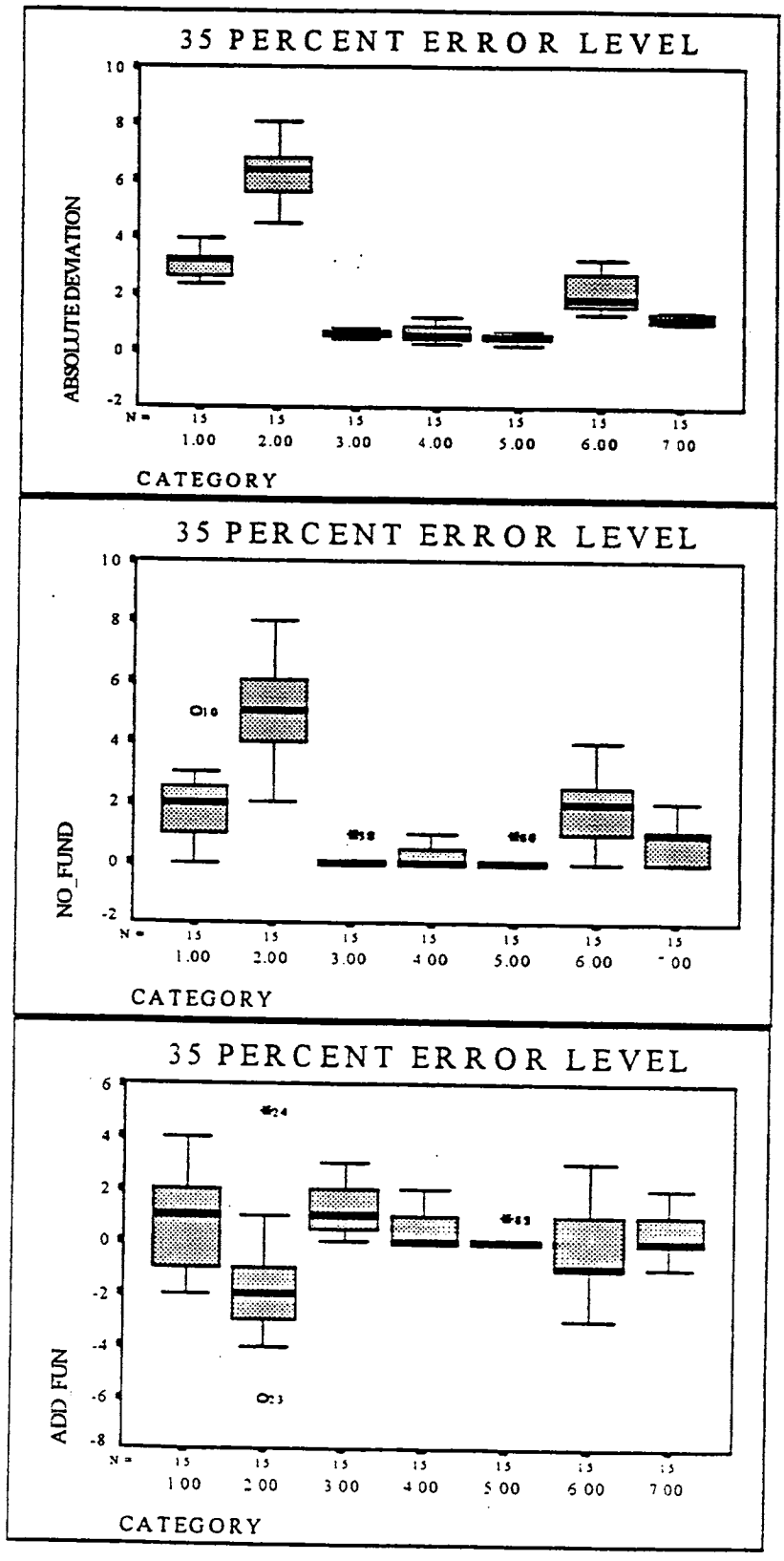


Figure I-16. Percent Error Results - 35

APPENDIX J. SAMPLE ANOVA TEST STATISTICS

Contents:

ANOVA results, descriptive statistics, and Levene, K-S, and Shapiro-Wilks test statistics for two cases (of 21 total), i.e.,

1. Cost-efficiency simulation across all error levels, and

2. 15 percent error applied to every category.

Absolute Difference

file: <err_norm> and <anov.lst>

----- ONEWAY -----
RURAL COST EFFICIENCY

Variable ABS_DEV
By Variable ERROR (2.5 TO 35 PERCENT)

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	7	102.4473	14.6353	156.9432	.0000
Within Groups	112	10.4443	.0933		
Total	119	112.8916			

Levene Test for Homogeneity of Variances

Statistic	df1	df2	2-tail Sig.
4.2628	7	112	.000

Multiple Range Tests: Modified LSD (Bonferroni) test with significance level .05

The difference between two means is significant if
MEAN(J)-MEAN(I) >= .2159 * RANGE * SQRT(1/N(I) + 1/N(J))
with the following value(s) for RANGE: 4.53
(*) Indicates significant differences which are shown in the lower triangle

Mean	ERROR	Grp 2	Grp 5	Grp10	Grp15	Grp20	Grp25	Grp30	Grp35
.3375	Grp 2								
.5458	Grp 5								
.9896	Grp10	*	*						
1.5458	Grp15	*	*	*					
1.7750	Grp20	*	*	*					
2.2375	Grp25	*	*	*	*	*			
2.6917	Grp30	*	*	*	*	*	*		
3.0625	Grp35	*	*	*	*	*	*	*	

Homogeneous Subsets (highest and lowest means are not significantly different)

Subset 1
Group Grp 2 Grp 5
Mean .3375 .5458

Subset 2
Group Grp10
Mean .9896

Subset 3
Group Grp15 Grp20
Mean 1.5458 1.7750

Subset 4
Group Grp25
Mean 2.2375

Subset 5
Group Grp30
Mean 2.6917

Subset 6
Group Grp35
Mean 3.0625

----- ONEWAY -----
RURAL COST-EFFICIENCY

Variable ABS_DEV
By Variable ERROR (2.5 TO 70 PERCENT, with 30 valid observations at the 35% error level)

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	14	776.8846	55.4918	186.5076	.0000
Within Groups	225	66.9444	.2975		
Total	239	843.8290			

2.5 to 70 PERCENT ERROR LEVEL (denoted by group i.d.)
DESCRIPTIVE STATISTICS:

Group	Count	Standard Mean	Standard Deviation	Error	Minimum	Maximum	95 Pct Conf Int for Mean
Grp 2	15	.3375	.1223	.0316	.1563	.5313	.2698 TO .4052
Grp 5	15	.5458	.1479	.0382	.3438	.8750	.4639 TO .6278
Grp10	15	.9896	.2202	.0569	.5938	1.3750	.8676 TO 1.1115
Grp15	15	1.5458	.3091	.0798	.8750	2.0313	1.3747 TO 1.7170
Grp20	15	1.7750	.3176	.0820	1.3125	2.2813	1.5991 TO 1.9509
Grp25	15	2.2375	.2449	.0632	1.7188	2.6875	2.1019 TO 2.3731
Grp30	15	2.6917	.4380	.1131	1.8438	3.7813	2.4491 TO 2.9342
Grp35	30	3.1427	.4853	.0886	2.0625	4.0000	2.9615 TO 3.3239
Grp40	15	3.4063	.7925	.2046	2.3750	5.8438	2.9674 TO 3.8451
Grp45	15	4.2417	.7302	.1885	3.5000	6.5000	3.8373 TO 4.6460
Grp50	15	4.2625	.5594	.1444	3.1875	5.1563	3.9527 TO 4.5723
Grp55	15	5.1146	.7854	.2028	3.9688	7.0313	4.6796 TO 5.5495
Grp60	15	5.0750	.6576	.1698	3.5938	5.9688	4.7108 TO 5.4392
Grp65	15	6.0375	.6039	.1559	4.9063	6.9688	5.7031 TO 6.3719
Grp70	15	6.0708	.9340	.2411	4.3750	7.7500	5.5536 TO 6.5880
Total	240	3.1635	1.8790	.1213	.1563	7.7500	2.9246 TO 3.4025

Levene Test for Homogeneity of Variances

Statistic	df1	df2	2-tail Sig.
3.8920	14	225	.000

Multiple Range Tests: Modified LSD (Bonferroni) test with significance level .05
The difference between two means is significant if
MEAN(J)-MEAN(I) >= .3857 * RANGE * SQRT(1/N(I) + 1/N(J))
with the following value(s) for RANGE: 5.01
(*) Indicates significant differences which are shown in the lower triangle

Mean	ERROR	Grp 2	Grp 5	Grp10	Grp15	Grp20	Grp25	Grp30	Grp35	Grp40	Grp45	Grp50	Grp60	Grp55	Grp65	Grp70
.3375	Grp 2															
.5458	Grp 5															
.9896	Grp10															
1.5458	Grp15	*	*													
1.7750	Grp20	*	*	*												
2.2375	Grp25	*	*	*												
2.6917	Grp30	*	*	*	*	*										
3.1427	Grp35	*	*	*	*	*	*									
3.4063	Grp40	*	*	*	*	*	*	*								
4.2417	Grp45	*	*	*	*	*	*	*	*	*						
4.2625	Grp50	*	*	*	*	*	*	*	*	*						
5.0750	Grp60	*	*	*	*	*	*	*	*	*	*	*				
5.1146	Grp55	*	*	*	*	*	*	*	*	*	*	*				
6.0375	Grp65	*	*	*	*	*	*	*	*	*	*	*	*	*		
6.0708	Grp70	*	*	*	*	*	*	*	*	*	*	*	*	*		

RURAL COST-EFFICIENCY

ABS_DEV
By ERROR 2.5
Valid cases: 15.0 Missing cases: .0 Percent missing: .0
Skewness -.2066 S E Skew .5801
Kurtosis -1.0500 S E Kurt 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.1563	.1563	.1875	.3438	.4375	.5125	.
Tukey's Hinges			.2344	.3438	.4219		

	Statistic	df	Significance
Shapiro-Wilks	.9377	15	.3997
K-S (Lilliefors)	.1567	15	> .2000

***ACCEPT NORMALITY Ho.

ABS_DEV
By ERROR 5.0
Valid cases: 15.0 Missing cases: .0 Percent missing: .0
Skewness .6839 S E Skew .5801
Kurtosis .2228 S E Kurt 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.3438	.3625	.4375	.5313	.6563	.8000	.
Tukey's Hinges			.4531	.5313	.6406		

	Statistic	df	Significance
Shapiro-Wilks	.9556	15	.5891
K-S (Lilliefors)	.1218	15	> .2000

***ACCEPT NORMALITY Ho.

ABS_DEV
By ERROR 10.0
Valid cases: 15.0 Missing cases: .0 Percent missing: .0
Skewness -.2922 S E Skew .5801
Kurtosis -.4113 S E Kurt 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.5938	.6313	.8125	1.0313	1.1563	1.3000	.
Tukey's Hinges			.8594	1.0313	1.1406		

	Statistic	df	Significance
Shapiro-Wilks	.9705	15	.8282
K-S (Lilliefors)	.0913	15	> .2000

***ACCEPT NORMALITY Ho.

ABS_DEV
By ERROR 15.0
Valid cases: 15.0 Missing cases: .0 Percent missing: .0
Skewness -.4868 S E Skew .5801
Kurtosis .0804 S E Kurt 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.8750	1.0438	1.3438	1.5313	1.8125	1.9563	.
Tukey's Hinges			1.3750	1.5313	1.7656		

	Statistic	df	Significance
Shapiro-Wilks	.9792	15	.9421
K-S (Lilliefors)	.0582	15	> .2000

***ACCEPT NORMALITY Ho.

Section J1 - Category Simulation

ABS_DEV
By ERROR 20.0
Valid cases: 15.0 Missing cases: .0 Percent missing: .0
Skewness .1498 S E Skew .5801
Kurtosis -1.2367 S E Kurt 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	1.3125	1.3125	1.5625	1.7188	2.1250	2.2063	.
Tukey's Hinges			1.5781	1.7188	2.0938		

	Statistic	df	Significance
Shapiro-Wilks	.9342	15	.3707
K-S (Lilliefors)	.1314	15	> .2000

***ACCEPT NORMALITY Ho.

ABS_DEV
By ERROR 25.0
Valid cases: 15.0 Missing cases: .0 Percent missing: .0
Skewness .0104 S E Skew .5801
Kurtosis .4968 S E Kurt 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	1.7188	1.9063	2.0938	2.2188	2.4375	2.6313	.
Tukey's Hinges			2.0938	2.2188	2.3594		

	Statistic	df	Significance
Shapiro-Wilks	.9623	15	.6965
K-S (Lilliefors)	.1624	15	> .2000

***ACCEPT NORMALITY Ho.

ABS_DEV
By ERROR 30.0
Valid cases: 15.0 Missing cases: .0 Percent missing: .0
Skewness .6552 S E Skew .5801
Kurtosis 2.2723 S E Kurt 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	1.8438	2.0875	2.4688	2.6875	2.9688	3.3500	.
Tukey's Hinges			2.4844	2.6875	2.8750		

	Statistic	df	Significance
Shapiro-Wilks	.9433	15	.4455
K-S (Lilliefors)	.1523	15	> .2000

***ACCEPT NORMALITY Ho.

ABS_DEV
By ERROR 35.0
Valid cases: 30.0 Missing cases: .0 Percent missing: .0
Skewness -.3399 S E Skew .4269
Kurtosis -.4868 S E Kurt .8327

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	2.2172	2.4219	2.7109	3.1875	3.4766	3.7469	3.9656
Tukey's Hinges			2.7188	3.1875	3.4688		

	Statistic	df	Significance
Shapiro-Wilks	.9699	30	.5736
K-S (Lilliefors)	.0778	30	> .2000

***ACCEPT NORMALITY Ho.

ABS_DEV
By ERROR 40.0
Valid cases: 15.0 **Missing cases:** .0 **Percent missing:** .0
Skewness 2.1628 **S E Skew** .5801
Kurtosis 6.5005 **S E Kurt** 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	2.3750	2.6563	2.9063	3.2500	3.5938	4.7375	.
Tukey's Hinges			2.9375	3.2500	3.5781		

	Statistic	df	Significance
Shapiro-Wilks	.7930	15	< .0100
K-S (Lilliefors)	.2065	15	.0849

***CONFLICTING STATISTICS, TWO OUTLIERS WITH > DEVIATIONS
DISTRIBUTION COULD BE PLATYKURTIC (SEE OTHER SUM.STATS)

ABS_DEV
By ERROR 45.0
Valid cases: 15.0 **Missing cases:** .0 **Percent missing:** .0
Skewness 2.2762 **S E Skew** .5801
Kurtosis 6.5892 **S E Kurt** 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	3.5000	3.5750	3.7813	4.0625	4.4063	5.5063	.
Tukey's Hinges			3.8125	4.0625	4.4063		

	Statistic	df	Significance
Shapiro-Wilks	.7764	15	< .0100
K-S (Lilliefors)	.2108	15	.0716

***CONFLICTING STATISTICS. NPPLOTS SUGGEST NORMALITY (SEE OTHER SUM.STATS)

ABS_DEV
By ERROR 50.0
Valid cases: 15.0 **Missing cases:** .0 **Percent missing:** .0
Skewness -.2756 **S E Skew** .5801
Kurtosis -.6282 **S E Kurt** 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	3.1875	3.4313	3.7813	4.3750	4.6875	5.0063	.
Tukey's Hinges			3.8438	4.3750	4.6250		

	Statistic	df	Significance
Shapiro-Wilks	.9772	15	.9219
K-S (Lilliefors)	.0728	15	> .2000

***ACCEPT NORMALITY Ho.

ABS_DEV
By ERROR 55.0
Valid cases: 15.0 **Missing cases:** .0 **Percent missing:** .0
Skewness .9044 **S E Skew** .5801
Kurtosis 1.3404 **S E Kurt** 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	3.9688	4.1000	4.5000	5.0938	5.3750	6.5063	.
Tukey's Hinges			4.6094	5.0938	5.3750		

	Statistic	df	Significance
Shapiro-Wilks	.9438	15	.4493
K-S (Lilliefors)	.1701	15	> .2000

***ACCEPT NORMALITY Ho.

Section J1 - Category Simulation

ABS_DEV
By ERROR 60.0
Valid cases: 15.0 **Missing cases:** .0 **Percent missing:** .0
Skewness -.6786 **S E Skew** .5801
Kurtosis .2513 **S E Kurt** 1.1209

	Percentiles						
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	3.5938	4.0250	4.6875	5.0313	5.6875	5.9125	.
Tukey's Hinges			4.7813	5.0313	5.5938		

	Statistic	df	Significance
Shapiro-Wilks	.9537	15	.5600
K-S (Lilliefors)	.0871	15	> .2000

***ACCEPT NORMALITY Ho.

ABS_DEV
By ERROR 65.0
Valid cases: 15.0 **Missing cases:** .0 **Percent missing:** .0
Skewness -.1017 **S E Skew** .5801
Kurtosis -.6610 **S E Kurt** 1.1209

	Percentiles						
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	4.9063	5.1313	5.6563	6.0313	6.4375	6.9500	.
Tukey's Hinges			5.6563	6.0313	6.4063		

	Statistic	df	Significance
Shapiro-Wilks	.9743	15	.8895
K-S (Lilliefors)	.1189	15	> .2000

***ACCEPT NORMALITY Ho.

ABS_DEV
By ERROR 70.0
Valid cases: 15.0 **Missing cases:** .0 **Percent missing:** .0
Skewness .1140 **S E Skew** .5801
Kurtosis .3730 **S E Kurt** 1.1209

	Percentiles						
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	4.3750	4.5250	5.7813	6.0000	6.5000	7.7313	.
Tukey's Hinges			5.7813	6.0000	6.5000		

	Statistic	df	Significance
Shapiro-Wilks	.9424	15	.4379
K-S (Lilliefors)	.1229	15	> .2000

***ACCEPT NORMALITY Ho.

Number of Projects Previously Funded - Now Dropped

file: <numanov.lst>

----- ONEWAY -----
RURAL COST-EFFICIENCY

Variable NO_FUND
By Variable ERROR

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	14	1219.7167	87.1226	27.3067	.0000
Within Groups	225	717.8667	3.1905		
Total	239	1937.5833			

DESCRIPTIVES:

Group	Count	Mean	Standard Deviation	Standard Error	Minimum	Maximum	95 Pct Conf Int for Mean
Grp 2	15	.0667	.2582	.0667	.0000	1.0000	-.0763 TO .2097
Grp 5	15	.1333	.3519	.0909	.0000	1.0000	-.0615 TO .3282
Grp10	15	.7333	.5936	.1533	.0000	2.0000	.4046 TO 1.0621
Grp15	15	1.3333	.8997	.2323	.0000	3.0000	.8351 TO 1.8316
Grp20	15	1.0667	.7988	.2063	.0000	3.0000	.6243 TO 1.5090
Grp25	15	1.7333	.9612	.2482	1.0000	4.0000	1.2011 TO 2.2656
Grp30	15	3.4667	1.6417	.4239	1.0000	6.0000	2.5575 TO 4.3758
Grp35	30	2.4000	1.7538	.3202	.0000	7.0000	1.7451 TO 3.0549
Grp40	15	3.8667	2.7740	.7163	.0000	11.0000	2.3305 TO 5.4029
Grp45	15	4.3333	1.5430	.3984	2.0000	7.0000	3.4788 TO 5.1878
Grp50	15	4.9333	2.1202	.5474	2.0000	8.0000	3.7592 TO 6.1075
Grp55	15	5.4667	1.8848	.4866	2.0000	9.0000	4.4229 TO 6.5104
Grp60	15	5.2000	1.6987	.4386	2.0000	9.0000	4.2593 TO 6.1407
Grp65	15	6.8000	3.0284	.7819	3.0000	14.0000	5.1229 TO 8.4771
Grp70	15	7.4000	3.0190	.7795	3.0000	13.0000	5.7281 TO 9.0719
Total	240	3.2083	2.8473	.1838	.0000	14.0000	2.8463 TO 3.5704

Levene Test for Homogeneity of Variances

Statistic	df1	df2	2-tail Sig.
6.2243	14	225	.000

Multiple Range Tests: Modified LSD (Bonferroni) test with significance level .05

The difference between two means is significant if
MEAN(J)-MEAN(I) >= 1.2630 * RANGE * SQRT(1/N(I) + 1/N(J))
with the following value(s) for RANGE: 5.01
(*) Indicates significant differences which are shown in the lower triangle

Mean	ERROR	Grp 2	Grp 5	Grp10	Grp20	Grp15	Grp25	Grp35	Grp30	Grp40	Grp45	Grp50	Grp60	Grp55	Grp65	Grp70
.0667	Grp 2															
.1333	Grp 5															
.7333	Grp10															
1.0667	Grp20															
1.3333	Grp15															
1.7333	Grp25															
2.4000	Grp35	*	*													
3.4667	Grp30	*	*	*	*											
3.8667	Grp40	*	*	*	*	*										
4.3333	Grp45	*	*	*	*	*	*									
4.9333	Grp50	*	*	*	*	*	*	*								
5.2000	Grp60	*	*	*	*	*	*	*								
5.4667	Grp55	*	*	*	*	*	*	*								
6.8000	Grp65	*	*	*	*	*	*	*	*	*						
7.4000	Grp70	*	*	*	*	*	*	*	*	*	*					

Section J1 - Category Simulation

COST-EFFICIENCY CATEGORY

Valid cases: 15.0 **Missing cases:** .0 **Percent missing:** .0 (EXCEPT in 35% error level where two simulations are compared).

NO_FUND
By ERROR 2.5
Skewness 3.8730 S E Skew .5801
Kurtosis 15.0000 S E Kurt 1.1209

		Percentiles					
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.0000	.0000	.0000	.0000	.0000	.4000	.
Tukey's Hinges			.0000	.0000	.0000		

	Statistic	df	Significance
Shapiro-Wilks	.2813	15	< .0100
K-S (Lilliefors)	.5352	15	.0000

***REJECT NORMALITY Ho, TWO UNIQUE VALUES (0,1) -- ONE IS AN EXTREME.

NO_FUND
By ERROR 5.0
Skewness 2.4048 S E Skew .5801
Kurtosis 4.3491 S E Kurt 1.1209

		Percentiles					
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.0000	.0000	.0000	.0000	.0000	1.0000	.
Tukey's Hinges			.0000	.0000	.0000		

	Statistic	df	Significance
Shapiro-Wilks	.4104	15	< .0100
K-S (Lilliefors)	.5143	15	.0000

***REJECT NORMALITY Ho, TWO UNIQUE VALUES (0,1) -- ONE IS AN EXTREME.

NO_FUND
By ERROR 10.0
Skewness .0911 S E Skew .5801
Kurtosis -.1711 S E Kurt 1.1209

		Percentiles					
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.0000	.0000	.0000	1.0000	1.0000	1.4000	.
Tukey's Hinges			.0000	1.0000	1.0000		

	Statistic	df	Significance
Shapiro-Wilks	.7582	15	< .0100
K-S (Lilliefors)	.2600	15	.0374

***REJECT NORMALITY Ho, THREE UNIQUE VALUES (0,1,2) -- INCREASING DEVIATIONS

NO_FUND
By ERROR 15.0
Skewness .5784 S E Skew .5801
Kurtosis -.0056 S E Kurt 1.1209

		Percentiles					
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.0000	.0000	1.0000	1.0000	2.0000	3.0000	.
Tukey's Hinges			1.0000	1.0000	2.0000		

	Statistic	df	Significance
Shapiro-Wilks	.8526	15	.0188
K-S (Lilliefors)	.3112	15	.0304

***REJECT NORMALITY Ho, BUT NPPLOTS LOOK REASONABLY NORMAL
INCREASING DEVIATIONS AWAY FROM DIRECTION OF SKEW -- BOXPLOT SUGGESTS THAT
THE DISTRIBUTION IS LEPTOKURTIC AROUND MEDIAN (=1 .

Section J1 - Category Simulation

NO_FUND
By ERROR 20.0
Skewness .8422 **S E Skew** .5801
Kurtosis 1.4592 **S E Kurt** 1.1209

	Percentiles						
	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Percentiles							
Haverage	.0000	.0000	1.0000	1.0000	1.0000	2.4000	.
Tukey's Hinges			1.0000	1.0000	1.0000		

	Statistic	df	Significance
Shapiro-Wilks	.8174	15	< .0100
K-S (Lilliefors)	.3333	15	.0001

***REJECT NORMALITY Ho, 3 OF 4 UNIQUE VALUES ARE EXTREMES--INCREASING DEVIATIONS
DISTRIBUTION IS LEPTOKURTIC.

NO_FUND
By ERROR 25.0
Skewness 1.1724 **S E Skew** .5801
Kurtosis .5932 **S E Kurt** 1.1209

	Percentiles						
	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Percentiles							
Haverage	1.0000	1.0000	1.0000	1.0000	2.0000	3.4000	.
Tukey's Hinges			1.0000	1.0000	2.0000		

	Statistic	df	Significance
Shapiro-Wilks	.7730	15	< .0100
K-S (Lilliefors)	.3106	15	.0004

***REJECT NORMALITY Ho, 4 UNIQUE VALUES -- INCREASING DEVIATIONS FROM NORMAL
DISTRIBUTION IS NEGATIVELY SKEWED AND LOOKS TRUNCATED.

NO_FUND
By ERROR 30.0
Skewness .4591 **S E Skew** .5801
Kurtosis -.9711 **S E Kurt** 1.1209

	Percentiles						
	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Percentiles							
Haverage	1.0000	1.6000	2.0000	3.0000	5.0000	6.0000	.
Tukey's Hinges			2.0000	3.0000	4.5000		

	Statistic	df	Significance
Shapiro-Wilks	.8990	15	.0950
K-S (Lilliefors)	.2119	15	.0686

***ACCEPT NORMALITY Ho.

NO_FUND
By ERROR 35.0
Skewness 1.1440 **S E Skew** .4269
Kurtosis .8788 **S E Kurt** .8327

	Percentiles						
	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Percentiles							
Haverage	.0000	1.0000	1.0000	2.0000	3.0000	5.9000	6.4500
Tukey's Hinges			1.0000	2.0000	3.0000		

Valid cases: 15.0 **Missing cases:** .0 **Percent missing:** .0

	Statistic	df	Significance
Shapiro-Wilks	.8967	15	.0892
K-S (Lilliefors)	.2116	15	.0694

***ACCEPT NORMALITY Ho.
NOTE ALSO @:
Valid cases: 30.0 **Missing cases:** .0 **Percent missing:** .0

	Statistic	df	Significance
Shapiro-Wilks	.8688	30	< .0100
K-S (Lilliefors)	.2569	30	.0300

***REJECT NORMALITY Ho, COULD BE PLATYKURTIC (SEE OTHER SUM.STATISTICS)

NO_FUND
By ERROR 40.0
Skewness 1.3866 S E Skew .5801
Kurtosis 2.1321 S E Kurt 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.0000	1.2000	2.0000	3.0000	5.0000	9.2000	.
Tukey's Hinges			2.0000	3.0000	5.0000		

	Statistic	df	Significance
Shapiro-Wilks	.8570	15	.0223
K-S (Lilliefors)	.2893	15	.0014

***REJECT NORMALITY Ho, COULD BE PLATYKURTIC B/C OF OUTLIERS (SEE OTHER STAT)

NO_FUND
By ERROR 45.0
Skewness .4287 S E Skew .5801
Kurtosis -.2972 S E Kurt 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	2.0000	2.0000	4.0000	4.0000	6.0000	7.0000	.
Tukey's Hinges			4.0000	4.0000	5.0000		

	Statistic	df	Significance
Shapiro-Wilks	.8590	15	.0247
K-S (Lilliefors)	.3188	15	.0002

***REJECT NORMALITY Ho, CAN'T SEE IN NPPLOTS WHY.

NO_FUND
By ERROR 50.0
Skewness .0483 S E Skew .5801
Kurtosis -1.0131 S E Kurt 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	2.0000	2.0000	3.0000	5.0000	6.0000	8.0000	.
Tukey's Hinges			3.5000	5.0000	6.0000		

	Statistic	df	Significance
Shapiro-Wilks	.9156	15	.2190
K-S (Lilliefors)	.1167	15	> .2000

***ACCEPT NORMALITY Ho.

NO_FUND
By ERROR 55.0
Skewness .0228 S E Skew .5801
Kurtosis -.2525 S E Kurt 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	2.0000	2.6000	4.0000	6.0000	7.0000	8.4000	.
Tukey's Hinges			4.0000	6.0000	6.5000		

	Statistic	df	Significance
Shapiro-Wilks	.9775	15	.9254
K-S (Lilliefors)	.1219	15	> .2000

***ACCEPT NORMALITY Ho.

NO_FUND
By ERROR 60.0
Skewness .4479 S E Skew .5801
Kurtosis .7963 S E Kurt 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	2.0000	3.2000	4.0000	5.0000	6.0000	7.8000	.
Tukey's Hinges			4.0000	5.0000	6.0000		

	Statistic	df	Significance
Shapiro-Wilks	.9410	15	.4267
K-S (Lilliefors)	.1600	15	> .2000

***ACCEPT NORMALITY Ho.

NO_FUND
By ERROR 65.0
Skewness 1.1815 **S E Skew** .5801
Kurtosis 1.2588 **S E Kurt** 1.1209

		Percentiles					
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	3.0000	3.6000	4.0000	6.0000	8.0000	12.8000	.
Tukey's Hinges			4.5000	6.0000	7.5000		

	Statistic	df	Significance
Shapiro-Wilks	.8930	15	.0800
K-S (Lilliefors)	.2070	15	.0832

***ACCEPT NORMALITY Ho.

NO_FUND
By ERROR 70.0
Skewness .4371 **S E Skew** .5801
Kurtosis -.6557 **S E Kurt** 1.1209

		Percentiles					
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	3.0000	3.6000	5.0000	7.0000	10.0000	12.4000	.
Tukey's Hinges			5.0000	7.0000	9.0000		

	Statistic	df	Significance
Shapiro-Wilks	.9451	15	.4597
K-S (Lilliefors)	.1546	15	> .2000

***ACCEPT NORMALITY Ho.
Hi-Res Chart # 65:Boxplot of no_fund by error

Number of Additional Projects Funded

file: <numanov.lst>

----- ONEWAY -----
RURAL COST-EFFICIENCY

Variable ADD_FUND
By Variable ERROR

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	14	495.4292	35.3878	9.1199	.0000
Within Groups	225	873.0667	3.8803		
Total	239	1368.4958			

DESCRIPTIVES:

Group	Count	Standard Mean	Standard Deviation	Error	Minimum	Maximum	95 Pct Conf Int for Mean
Grp 2	15	.5333	.6399	.1652	.0000	2.0000	.1789 TO .8877
Grp 5	15	.8000	.5606	.1447	.0000	2.0000	.4895 TO 1.1105
Grp10	15	.3333	.7237	.1869	.0000	2.0000	-.0675 TO .7341
Grp15	15	.0000	.8452	.2182	-2.0000	2.0000	-.4680 TO .4680
Grp20	15	.2667	1.0998	.2840	-2.0000	2.0000	-.3424 TO .8757
Grp25	15	.3333	1.2344	.3187	-3.0000	2.0000	-.3503 TO 1.0169
Grp30	15	-1.6667	1.8387	.4748	-5.0000	1.0000	-2.6849 TO -.6484
Grp35	30	-.2667	2.3034	.4205	-6.0000	4.0000	-1.1268 TO .5934
Grp40	15	-1.7333	2.4919	.6434	-8.0000	1.0000	-3.1133 TO -.3534
Grp45	15	-1.6000	1.5946	.4117	-5.0000	1.0000	-2.4831 TO -.7169
Grp50	15	-2.4667	2.2318	.5762	-6.0000	1.0000	-3.7026 TO -1.2307
Grp55	15	-1.6000	2.1314	.5503	-5.0000	3.0000	-2.7803 TO -.4197
Grp60	15	-1.9333	1.7099	.4415	-5.0000	1.0000	-2.8803 TO -.9864
Grp65	15	-3.2000	3.0752	.7940	-10.0000	1.0000	-4.9030 TO -1.4970
Grp70	15	-4.2667	3.5550	.9179	-10.0000	2.0000	-6.2354 TO -2.2980
Total	240	-1.0458	2.3929	.1545	-10.0000	4.0000	-1.3501 TO -.7416

Levene Test for Homogeneity of Variances

Statistic	df1	df2	2-tail Sig.
5.8180	14	225	.000

Multiple Range Tests: Modified LSD (Bonferroni) test with significance level .05

The difference between two means is significant if
MEAN(J)-MEAN(I) >= 1.3929 * RANGE * SQRT(1/N(I) + 1/N(J))
with the following value(s) for RANGE: 5.01
(*) Indicates significant differences which are shown in the lower triangle

Mean	ERROR	Grp70	Grp65	Grp50	Grp60	Grp40	Grp30	Grp45	Grp55	Grp35	Grp15	Grp20	Grp10	Grp25	Grp 2	Grp 5
-4.2667	Grp70															
-3.2000	Grp65															
-2.4667	Grp50															
-1.9333	Grp60															
-1.7333	Grp40															
-1.6667	Grp30	*														
-1.6000	Grp45	*														
-1.6000	Grp55	*														
-.2667	Grp35	*	*													
.0000	Grp15	*	*													
.2667	Grp20	*	*	*												
.3333	Grp10	*	*	*												
.3333	Grp25	*	*	*												
.5333	Grp 2	*	*	*												
.8000	Grp 5	*	*	*	*											

COST EFFICIENCY CATEGORY

Valid cases: 15.0 **Missing cases:** .0 **Percent missing:** .0 **(EXCEPT in 35% error level where two simulations are compared).**

ADD_FUND
By ERROR 2.5
Skewness .8023 S E Skew .5801
Kurtosis -.1267 S E Kurt 1.1209

	Percentiles						
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.0000	.0000	.0000	.0000	1.0000	1.4000	.
Tukey's Hinges			.0000	.0000	1.0000		

	Statistic	df	Significance
Shapiro-Wilks	.7452	15	< .0100
K-S (Lilliefors)	.3310	15	.0001

***REJECT NORMALITY Ho, THREE UNIQUE VALUES (0,1,2) -- INCREASING DEVIATIONS AWAY FROM DISTRIBUTION SKEW.

ADD_FUND
By ERROR 5.0
Skewness -.1123 S E Skew .5801
Kurtosis .3783 S E Kurt 1.1209

	Percentiles						
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.0000	.0000	.0000	1.0000	1.0000	1.4000	.
Tukey's Hinges			.5000	1.0000	1.0000		

	Statistic	df	Significance
Shapiro-Wilks	.7340	15	< .0100
K-S (Lilliefors)	.2940	15	.0011

***REJECT NORMALITY Ho, THREE UNIQUE VALUES (0,1,2) -- INCREASING DEVIATIONS

ADD_FUND
By ERROR 10.0
Skewness 1.9808 S E Skew .5801
Kurtosis 2.5499 S E Kurt 1.1209

	Percentiles						
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.0000	.0000	.0000	.0000	.0000	2.0000	.
Tukey's Hinges			.0000	.0000	.0000		

	Statistic	df	Significance
Shapiro-Wilks	.5123	15	< .0100
K-S (Lilliefors)	.4774	15	.0000

***REJECT NORMALITY Ho, THREE UNIQUE VALUES (0,1,2) -- TWO ARE EXTREMES.

ADD_FUND
By ERROR 15.0
Skewness .0000 S E Skew .5801
Kurtosis 3.5538 S E Kurt 1.1209

	Percentiles						
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	-2.0000	-1.4000	.0000	.0000	.0000	1.4000	.
Tukey's Hinges			.0000	.0000	.0000		

	Statistic	df	Significance
Shapiro-Wilks	.7353	15	< .0100
K-S (Lilliefors)	.3667	15	.0000

***REJECT NORMALITY Ho, FIVE UNIQUE VALUES -- 4 OF WHICH ARE EXTREME VALUES.

ADD_FUND
By ERROR 20.0
Skewness -.2374 **S E Skew** .5801
Kurtosis .0456 **S E Kurt** 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	-2.0000	-1.4000	.0000	.0000	1.0000	2.0000	.
Tukey's Hinges			.0000	.0000	1.0000		

	Statistic	df	Significance
Shapiro-Wilks	.9267	15	.3101
K-S (Lilliefors)	.1958	15	.1263

***ACCEPT NORMALITY Ho.

ADD_FUND
By ERROR 25.0
Skewness -1.2658 **S E Skew** .5801
Kurtosis 3.0036 **S E Kurt** 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	-3.0000	-1.8000	.0000	.0000	1.0000	2.0000	.
Tukey's Hinges			.0000	.0000	1.0000		

	Statistic	df	Significance
Shapiro-Wilks	.8532	15	.0191
K-S (Lilliefors)	.1612	15	> .2000

***CONFLICTING STATS, NPPLOTS SHOW DECREASING DEVIATIONS SLIGHTLY SKEWED AWAY FROM ONE EXTREME VALUE. OTHERWISE LOOKS PRETTY NORMAL.

ADD_FUND
By ERROR 30.0
Skewness -.3300 **S E Skew** .5801
Kurtosis -1.0924 **S E Kurt** 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	-5.0000	-4.4000	-3.0000	-2.0000	.0000	.4000	.
Tukey's Hinges			-3.0000	-2.0000	.0000		

	Statistic	df	Significance
Shapiro-Wilks	.9221	15	.2725
K-S (Lilliefors)	.1157	15	> .2000

***ACCEPT NORMALITY Ho.

ADD_FUND
By ERROR 35.0
Skewness -.2670 **S E Skew** .4269
Kurtosis .3454 **S E Kurt** .8327

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	-4.9000	-3.9000	-1.2500	.0000	1.2500	1.9000	4.0000
Tukey's Hinges			-1.0000	.0000	1.0000		

Valid cases: 15.0 Missing cases: .0 Percent missing: .0

	Statistic	df	Significance
Shapiro-Wilks	.9215	15	.2675
K-S (Lilliefors)	.1949	15	.1299

***ACCEPT NORMALITY Ho.

Valid cases: 30.0 Missing cases: 0 Percent missing: .0

	Statistic	df	Significance
Shapiro-Wilks	.9670	30	.4993
K-S (Lilliefors)	.1206	30	> .2000

***ACCEPT NORMALITY Ho.

ADD_FUND
By ERROR 40.0
Skewness -1.2455 **S E Skew** .5801
Kurtosis 1.4641 **S E Kurt** 1.1209

		Percentiles					
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	-8.0000	-6.2000	-3.0000	-1.0000	.0000	1.0000	.
Tukey's Hinges			-3.0000	-1.0000	.0000		

	Statistic	df	Significance
Shapiro-Wilks	.8831	15	.0553
K-S (Lilliefors)	.1363	15	> .2000

***ACCEPT NORMALITY Ho.

ADD_FUND
By ERROR 45.0
Skewness -.2781 **S E Skew** .5801
Kurtosis -.0758 **S E Kurt** 1.1209

		Percentiles					
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	-5.0000	-3.8000	-3.0000	-2.0000	.0000	.4000	.
Tukey's Hinges			-2.5000	-2.0000	.0000		

	Statistic	df	Significance
Shapiro-Wilks	.9301	15	.3373
K-S (Lilliefors)	.1990	15	.1130

***ACCEPT NORMALITY Ho.

ADD_FUND
By ERROR 50.0
Skewness -.1620 **S E Skew** .5801
Kurtosis -1.0036 **S E Kurt** 1.1209

		Percentiles					
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	-6.0000	-6.0000	-4.0000	-2.0000	.0000	.4000	.
Tukey's Hinges			-4.0000	-2.0000	-.5000		

	Statistic	df	Significance
Shapiro-Wilks	.9486	15	.4887
K-S (Lilliefors)	.0873	15	> .2000

***ACCEPT NORMALITY Ho.

ADD_FUND
By ERROR 55.0
Skewness .4658 **S E Skew** .5801
Kurtosis .0700 **S E Kurt** 1.1209

		Percentiles					
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	-5.0000	-4.4000	-3.0000	-2.0000	.0000	1.8000	.
Tukey's Hinges			-3.0000	-2.0000	.0000		

	Statistic	df	Significance
Shapiro-Wilks	.9638	15	.7215
K-S (Lilliefors)	.1744	15	> .2000

***ACCEPT NORMALITY Ho.

ADD_FUND
By ERROR 60.0
Skewness .0793 **S E Skew** .5801
Kurtosis -.1876 **S E Kurt** 1.1209

		Percentiles					
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	-5.0000	-4.4000	-3.0000	-2.0000	-1.0000	1.0000	.
Tukey's Hinges			-3.0000	-2.0000	-1.0000		

	Statistic	df	Significance
Shapiro-Wilks	.9471	15	.4765
K-S (Lilliefors)	.1593	15	> .2000

***ACCEPT NORMALITY Ho.

Section J1 - Category Simulation

ADD_FUND
By ERROR 65.0
Skewness -1.0753 S E Skew .5801
Kurtosis .8772 S E Kurt 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	-10.0000	-9.4000	-5.0000	-3.0000	-1.0000	.4000	.
Tukey's Hinges			-4.5000	-3.0000	-1.0000		

	Statistic	df	Significance
Shapiro-Wilks	.9014	15	.1032
K-S (Lilliefors)	.1039	15	> .2000

***ACCEPT NORMALITY Ho.

ADD_FUND
By ERROR 70.0
Skewness .0327 S E Skew .5801
Kurtosis -.5979 S E Kurt 1.1209

		Percentiles				
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	-10.0000	-9.4000	-7.0000	-4.0000	-2.0000	1.4000	.
Tukey's Hinges			-6.5000	-4.0000	-2.5000		

	Statistic	df	Significance
Shapiro-Wilks	.9694	15	.8105
K-S (Lilliefors)	.1085	15	> .2000

***ACCEPT NORMALITY Ho.

----- ONEWAY -----
15 PERCENT ERROR LEVEL

file: <cat_norm> and <anov.lst>

Variable MAD
By Variable CATEGORY

	Analysis of Variance				
Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	6	101.7491	16.9582	305.3886	0.0000
Within Groups	98	5.4419	.0555		
Total	104	107.1911			

Group	Count	Mean	Standard Deviation	Standard Error	Minimum	Maximum	95 Pct Conf Int for Mean
Grp 1	15	1.5458	.3091	.0798	.8750	2.0313	1.3747 TO 1.7170
Grp 2	15	3.0646	.4895	.1264	2.2188	3.8750	2.7935 TO 3.3357
Grp 3	15	.3458	.1178	.0304	.1563	.5938	.2806 TO .4111
Grp 4	15	.1104	.0552	.0143	.0313	.2188	.0798 TO .1410
Grp 5	15	.2396	.1061	.0274	.0000	.3750	.1808 TO .2983
Grp 6	15	.4292	.1092	.0282	.2813	.5938	.3687 TO .4896
Grp 7	15	.5958	.1160	.0300	.2813	.7813	.5316 TO .6601
Total	105	.9045	1.0152	.0991	.0000	3.8750	.7080 TO 1.1009

Levene Test for Homogeneity of Variances

Statistic	df1	df2	2-tail Sig.
15.7170	6	98	.000

----- ONEWAY -----
15 PERCENT ERROR LEVEL

Variable MAD
By Variable CATEGORY

Multiple Range Tests: Modified LSD (Bonferroni) test with significance level .05
The difference between two means is significant if

MEAN(J)-MEAN(I) >= .1666 * RANGE * SQRT(1/N(I) + 1/N(J))
with the following value(s) for RANGE: 4.41
(*) Indicates significant differences which are shown in the lower triangle

Mean	CATEGORY	Grp 4	Grp 5	Grp 3	Grp 6	Grp 7	Grp 1	Grp 2
.1104	Grp 4							
.2396	Grp 5							
.3458	Grp 3							
.4292	Grp 6	*						
.5958	Grp 7	*	*					
1.5458	Grp 1	*	*	*	*	*		
3.0646	Grp 2	*	*	*	*	*	*	

Homogeneous Subsets (highest and lowest means are not significantly different)

Subset 1

Group	Grp 4	Grp 5	Grp 3
Mean	.1104	.2396	.3458

Subset 2

Group	Grp 5	Grp 3	Grp 6
Mean	.2396	.3458	.4292

Subset 3

Group	Grp 3	Grp 6	Grp 7
Mean	.3458	.4292	.5958

Subset 4

Group	Grp 1
Mean	1.5458

Subset 5

Group	Grp 2
Mean	3.0646

---

15 PERCENT ERROR LEVEL

DESCRIPTIVES:

Variable	Mean (std err)	Std.Dev	Median	Variance	Min	Max	Range	Skewness (std.err)	Kurtosis (std.err)	95% CI for Mean
Cost-efficiency	1.55 (.0798)	0.3091	1.53	0.0955	0.875	2.03	1.16	-0.4868 (.5801)	0.0804 (1.12)	1.37, 1.72
Community support	3.06 (.1264)	0.4895	3.16	0.2396	2.22	3.88	1.66	-0.2004 (.5801)	-0.9381 (1.12)	2.79, 3.34
Wetlands	0.3458 (.0304)	0.1178	0.3438	0.0139	0.1563	0.594	0.4375	0.5219 (.5801)	0.1860 (1.12)	0.2806, 0.4111
Water quality	0.1104 (.0143)	0.0552	0.0938	0.0031	0.0313	0.2188	0.1875	0.8322 (.5801)	0.2535 (1.12)	0.0798, 0.1410
Noise	0.2396 (.0274)	0.1061	0.25	0.0113	0.00	0.375	0.375	-0.9209 (.5801)	0.7096 (1.12)	0.1808, 0.2983
Mode integration	0.4292 (.0282)	0.1092	0.4375	0.0119	0.2813	0.5938	0.3125	0.0599 (.5801)	-1.4692 (1.12)	0.3687, 0.4896
Land use	0.5958 (.03)	0.116	0.5938	0.0135	0.2813	0.7813	0.5	-1.1335 (.5801)	3.3569 (1.12)	0.5316, 0.6601

NOTE: Categories are numbered in the order shown above. [i.e., cost-efficiency is category 1.00, community support is 2.00, etc.]

Hi-Res Charts: Normal q-q plots and Detrended normal q-q plots were produced for each summary measure (i.e., mad, no_fund, add_fund) for each criteria category (see samples in Appendix K).
Shapiro-Wilks and K-S Lillifors test statistics for normality as recorded below.
Finally, a Hi-Res Boxplot for each summary measure by category is produced (see Appendix I).

Stat OUTPUT: 11 Dec 96 SPSS for MS WINDOWS Release 6.1 This software is functional through February 28, 1997.

Absolute Difference

Valid cases: 15.0 **Missing cases:** .0 **Percent missing:** .0

Variable MAD
By Variable CATEGORY 1.00

Percentiles

			Percentiles				
	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.8750	1.0438	1.3438	1.5313	1.8125	1.9563	.
Tukey's Hinges			1.3750	1.5313	1.7656		

	Statistic	df	Significance
Shapiro-Wilks	.9792	15	.9421
K-S (Lilliefors)	.0582	15	> .2000

***ACCEPT NORMALITY Ho

Variable MAD
By Variable CATEGORY 2.00

			Percentiles				
	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	2.2188	2.3125	2.5938	3.1563	3.5313	3.6875	.
Tukey's Hinges			2.6563	3.1563	3.4531		

Statistic	df	Significance
Shapiro-Wilks	.9672	.7755
K-S (Lilliefors)	.0986	15 > .2000

***ACCEPT NORMALITY Ho

Variable MAD
By Variable CATEGORY 3.00

	Percentiles						
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.1563	.1938	.2500	.3438	.4063	.5563	.
Tukey's Hinges			.2656	.3438	.4063		

	Statistic	df	Significance
Shapiro-Wilks	.9574	15	.6179
K-S (Lilliefors)	.1707	15	> .2000

***ACCEPT NORMALITY Ho

Variable MAD
By Variable CATEGORY 4.00

	Percentiles						
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.0313	.0500	.0625	.0938	.1250	.2188	.
Tukey's Hinges			.0625	.0938	.1250		

	Statistic	df	Significance
Shapiro-Wilks	.8990	15	.0951
K-S (Lilliefors)	.1959	15	.1260

***ACCEPT NORMALITY Ho

Variable MAD
By Variable CATEGORY 5.00

	Percentiles						
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.0000	.0375	.1875	.2500	.3125	.3750	.
Tukey's Hinges			.2031	.2500	.2969		

	Statistic	df	Significance
Shapiro-Wilks	.9260	15	.2044
K-S (Lilliefors)	.1009	15	> .2000

***ACCEPT NORMALITY Ho

Variable MAD
By Variable CATEGORY 6.00

	Percentiles						
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.2813	.2813	.3125	.4375	.5313	.5750	.
Tukey's Hinges			.3281	.4375	.5313		

	Statistic	df	Significance
Shapiro-Wilks	.9253	15	.2383
K-S (Lilliefors)	.1240	15	> .2000

***ACCEPT NORMALITY Ho

Variable MAD
By Variable CATEGORY 7.00

	Percentiles						
Percentiles	5.0000	10.0000	25.0000	50.0000	75.0000	90.0000	95.0000
Haverage	.2813	.4125	.5313	.5938	.6563	.7625	.
Tukey's Hinges			.5625	.5938	.6406		

	Statistic	df	Significance
Shapiro-Wilks	.8880	15	.0875
K-S (Lilliefors)	.1341	15	> .2000

***ACCEPT NORMALITY Ho

Number of Projects Previously Funded - Now Dropped

15 PERCENT ERROR LEVEL

Valid cases: 15.0 **Missing cases:** .0 **Percent missing:** .0

NO_FUND
By CATEGORY 1.00

	Statistic	df	Significance
Shapiro-Wilks	.8526	15	.0188
K-S (Lilliefors)	.3112	15	.0004

***REJECT NORMALITY Ho. FOUR UNIQUE VALUES {0,1,2,3} NPPLOTS SHOW INCREASING DEVIATION FROM NORMAL.

NO_FUND
By CATEGORY 2.00

	Statistic	df	Significance
Shapiro-Wilks	.6949	15	< .0100
K-S (Lilliefors)	.3450	15	.0000

***REJECT NORMALITY Ho. FOUR UNIQUE VALUES. NPPLOTS SHOW ONE EXTREME DEVIATION FROM NORMAL IN OPPOSITE DIRECTION OF SKEW AS SHOWN IN BOXPLOT.

NO_FUND
By CATEGORY 3.00
>Note # 17570. Command name: EXAMINE
>The number of unique data values for this cell is equal to one. The cell will be included in any boxplots produced but other output will be omitted.

NO_FUND
By CATEGORY 4.00
>Note # 17570. Command name: EXAMINE
>The number of unique data values for this cell is equal to one. The cell will be included in any boxplots produced but other output will be omitted.

NO_FUND
By CATEGORY 5.00
>Note # 17570. Command name: EXAMINE
>The number of unique data values for this cell is equal to one. The cell will be included in any boxplots produced but other output will be omitted.

NO_FUND
By CATEGORY 6.00

	Statistic	df	Significance
Shapiro-Wilks	.6339	15	< .0100
K-S (Lilliefors)	.3849	15	.0000

***REJECT NORMALITY Ho. TWO UNIQUE VALUES {0,1} – NO DISCERNABLE TREND.

NO_FUND
By CATEGORY 7.00

	Statistic	df	Significance
Shapiro-Wilks	.4104	15	< .0100
K-S (Lilliefors)	.5143	15	.0000

***REJECT NORMALITY Ho. TWO UNIQUE VALUES {0,1} – NO DISCERNABLE TREND.

Number of Additional Projects Funded

15 PERCENT ERROR LEVEL

Valid cases: 15.0 Missing cases: .0 Percent missing: .0

ADD_FUN
By CATEGORY 1.00

	Statistic	df	Significance
Shapiro-Wilks	.7353	15	< .0100
K-S (Lilliefors)	.3667	15	.0000

***REJECT NORMALITY Ho, FOUR OF FIVE UNIQUE VALUES ARE EXTREME VALUES SO THE DISTRIBUTION IS LEPTOKURTIC.

ADD_FUN
By CATEGORY 2.00

	Statistic	df	Significance
Shapiro-Wilks	.7647	15	< .0100
K-S (Lilliefors)	.1419	15	> .2000

***CONFLICTING STATISTICS. NPPLOT SHOWS DECREASING DEVIATIONS WHICH ARE SLIGHTLY SKEWED AWAY FROM ONE EXTREME VALUE (SEE BOXPLOT).

ADD_FUN
By CATEGORY 3.00

	Statistic	df	Significance
Shapiro-Wilks	.6474	15	< .0100
K-S (Lilliefors)	.3158	15	.0003

***REJECT NORMALITY Ho, TWO UNIQUE VALUES {0,1} -- NO DISCERNABLE TREND.

ADD_FUN
By CATEGORY 4.00

	Statistic	df	Significance
Shapiro-Wilks	.4995	15	< .0100
K-S (Lilliefors)	.4855	15	.0000

***REJECT NORMALITY Ho, TWO UNIQUE VALUES {0,1} -- NO DISCERNABLE TREND.

ADD_FUN
By CATEGORY 5.00

>Note # 17570. Command name: EXAMINE
>The number of unique data values for this cell is equal to one. The cell will be included in any boxplots produced but other output will be omitted.

ADD_FUN
By CATEGORY 6.00

	Statistic	df	Significance
Shapiro-Wilks	.7452	15	< .0100
K-S (Lilliefors)	.3310	15	.0001

***REJECT NORMALITY Ho, THREE UNIQUE VALUES {0,1,2} -- INCREASING DEVIATIONS.

ADD_FUN
By CATEGORY 7.00

	Statistic	df	Significance
Shapiro-Wilks	.7582	15	< .0100
K-S (Lilliefors)	.2600	15	.0074

***REJECT NORMALITY Ho, THREE UNIQUE VALUES {0,1,2} -- INCREASING DEVIATIONS.

Number of Additional Projects Funded

15 PERCENT ERROR LEVEL

Valid cases: 15.0 **Missing cases:** .0 **Percent missing:** .0

ADD_FUN
By CATEGORY 1.00

	Statistic	df	Significance
Shapiro-Wilks	.7353	15	< .0100
K-S (Lilliefors)	.3667	15	.0000

***REJECT NORMALITY Ho, FOUR OF FIVE UNIQUE VALUES ARE EXTREME VALUES SO THE DISTRIBUTION IS LEPTOKURTIC.

ADD_FUN
By CATEGORY 2.00

	Statistic	df	Significance
Shapiro-Wilks	.7647	15	< .0100
K-S (Lilliefors)	.1419	15	> .2000

***CONFLICTING STATISTICS. NPPLOT SHOWS DECREASING DEVIATIONS WHICH ARE SLIGHTLY SKEWED AWAY FROM ONE EXTREME VALUE (SEE BOXPLOT).

ADD_FUN
By CATEGORY 3.00

	Statistic	df	Significance
Shapiro-Wilks	.6474	15	< .0100
K-S (Lilliefors)	.3158	15	.0003

***REJECT NORMALITY Ho, TWO UNIQUE VALUES {0,1} – NO DISCERNABLE TREND.

ADD_FUN
By CATEGORY 4.00

	Statistic	df	Significance
Shapiro-Wilks	.4995	15	< .0100
K-S (Lilliefors)	.4855	15	.0000

***REJECT NORMALITY Ho, TWO UNIQUE VALUES {0,1} – NO DISCERNABLE TREND.

ADD_FUN
By CATEGORY 5.00

>Note # 17570. Command name: EXAMINE
>The number of unique data values for this cell is equal to one. The cell will be included in any boxplots produced but other output will be omitted.

ADD_FUN
By CATEGORY 6.00

	Statistic	df	Significance
Shapiro-Wilks	.7452	15	< .0100
K-S (Lilliefors)	.3310	15	.0001

***REJECT NORMALITY Ho, THREE UNIQUE VALUES {0,1,2} – INCREASING DEVIATIONS.

ADD_FUN
By CATEGORY 7.00

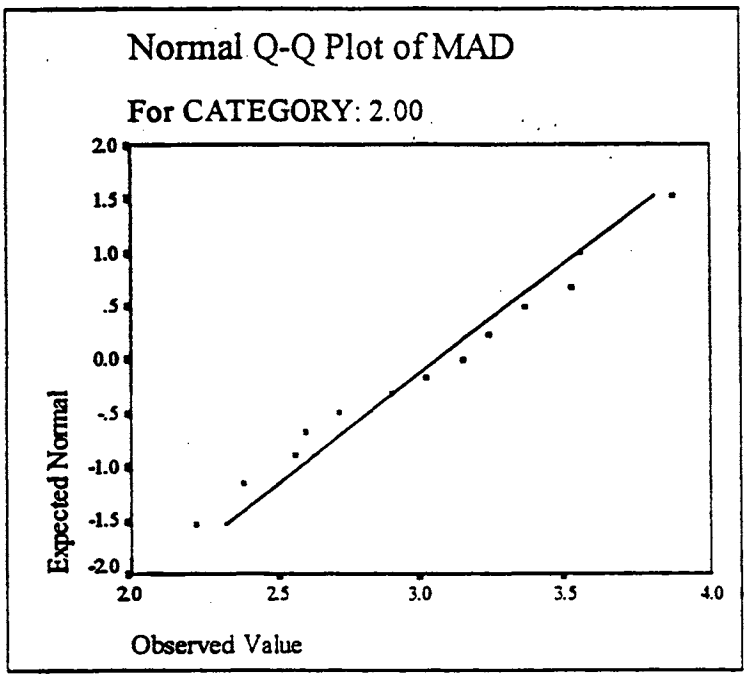
	Statistic	df	Significance
Shapiro-Wilks	.7582	15	< .0100
K-S (Lilliefors)	.2600	15	.0074

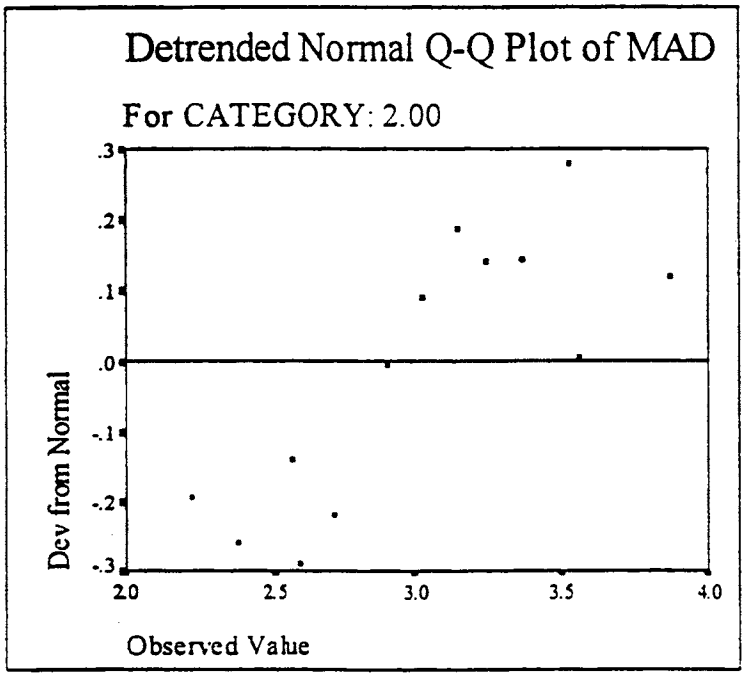
***REJECT NORMALITY Ho, THREE UNIQUE VALUES {0,1,2} – INCREASING DEVIATIONS.

APPENDIX K. SAMPLE NORMAL PROBABILITY PLOTS FOR SUMMARY MEASURES

Figure K-1. *Normally Distributed Example*

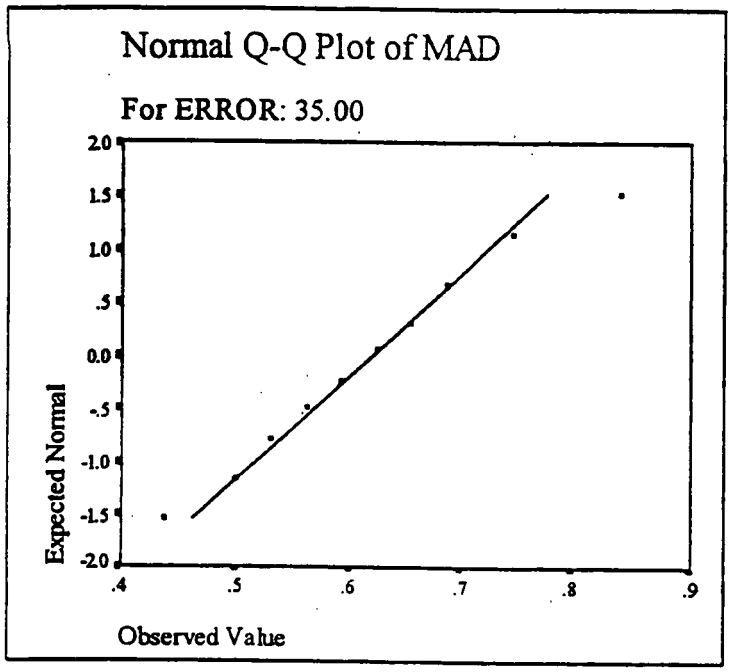
EXAMPLE OF NORMALLY DISTRIBUTED MEASURE

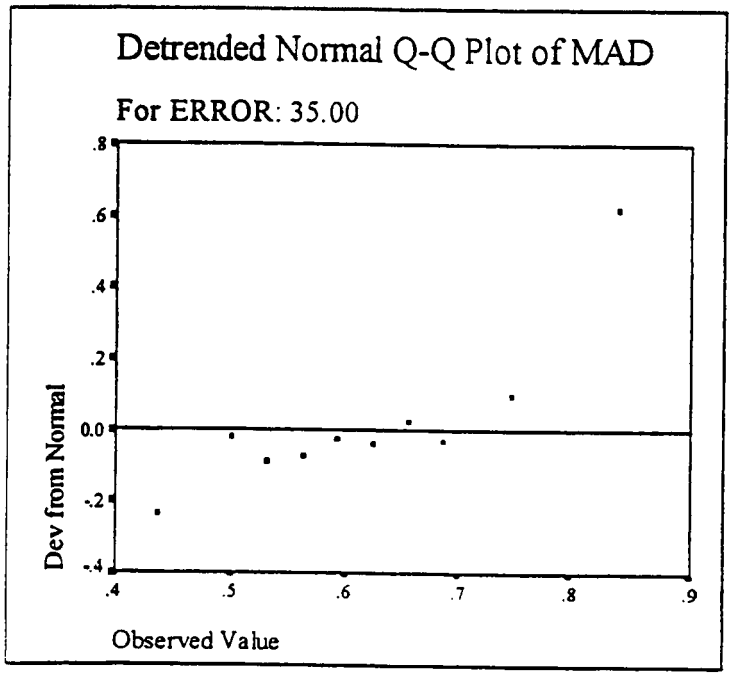




	Statistic	df	Significance	
Shapiro-Wilks	.9672	15	.7755	
K-S (Lilliefors)	.0986	15	> .2000	(sample from 15 percent error level)

Figure K-1 (continued). EXAMPLE OF NORMALLY DISTRIBUTED MEASURE:



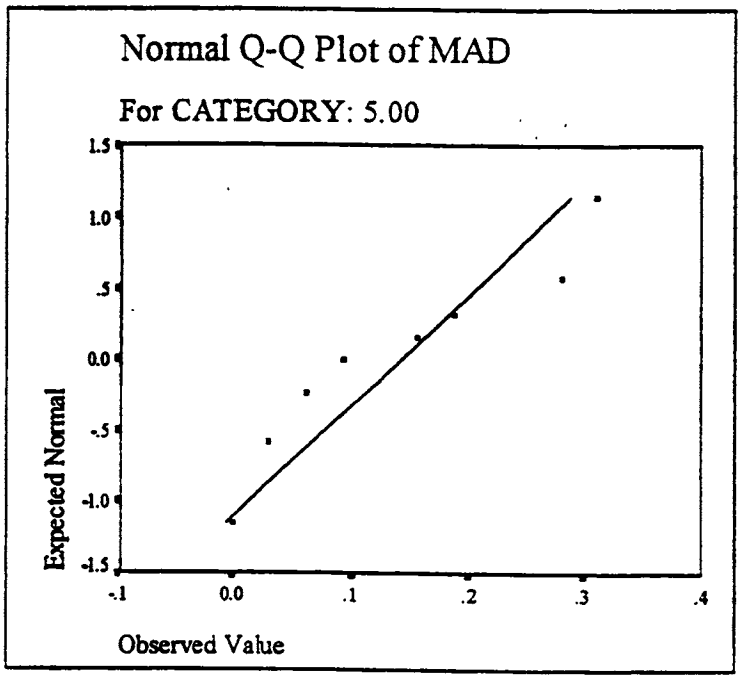


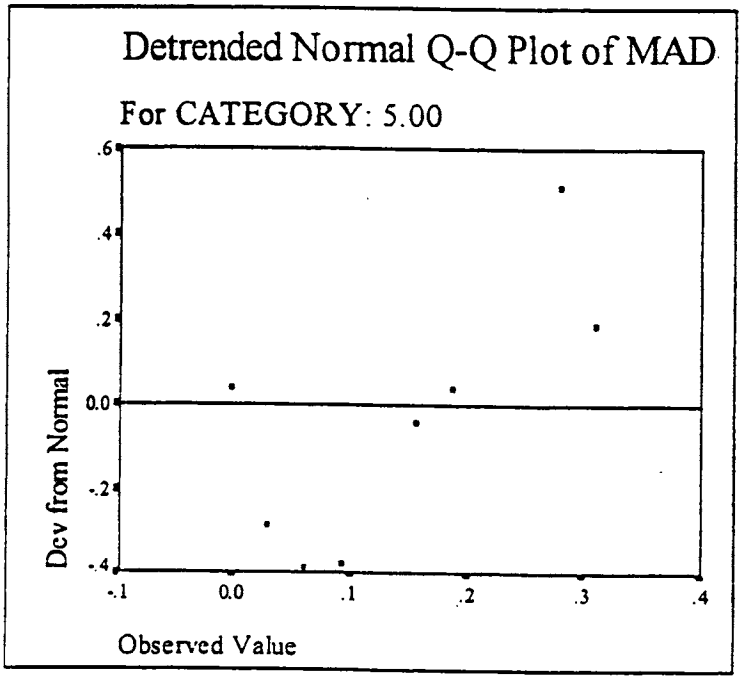
	Statistic	df	Significance
Shapiro-Wilks	.9818	15	.9633
K-S (Lilliefors)	.1265	15	> .2000

(sample from wetlands category)

Figure K-2. *"Borderline" Normal Examples*

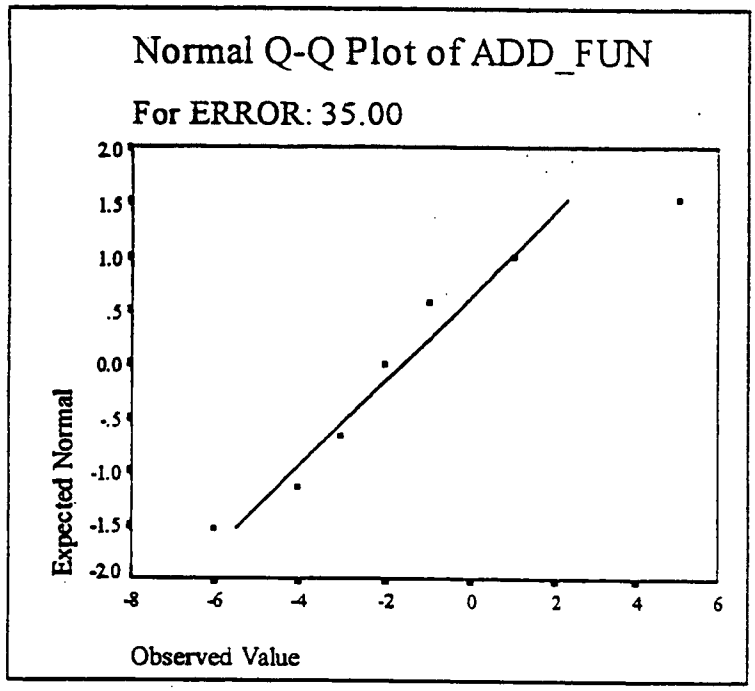
EXAMPLE OF MEASURE DISTRIBUTION THAT IS: "BORDERLINE" NORMAL

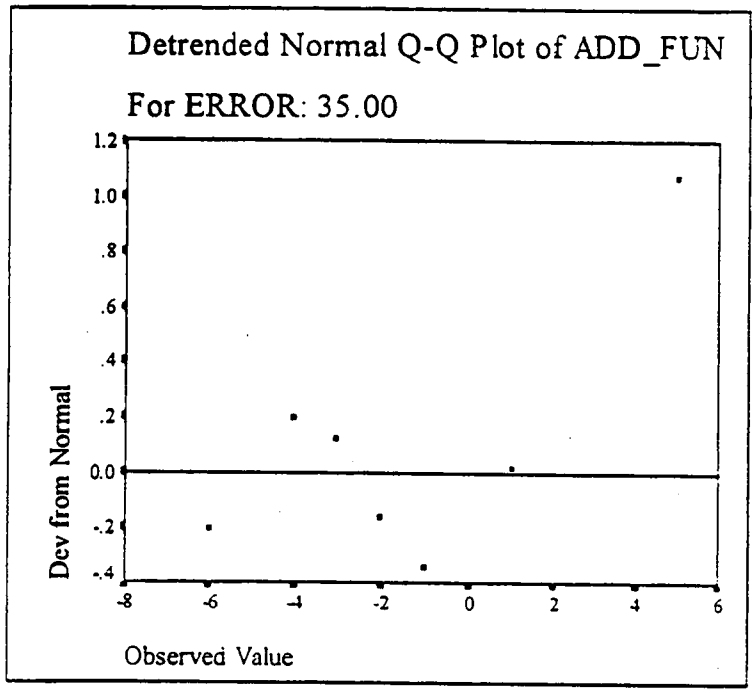




	Statistic	df	Significance	
Shapiro-Wilks	.8447	15	.0148	
K-S (Lilliefors)	.1990	15	.1130	(sample from 10 percent error level)

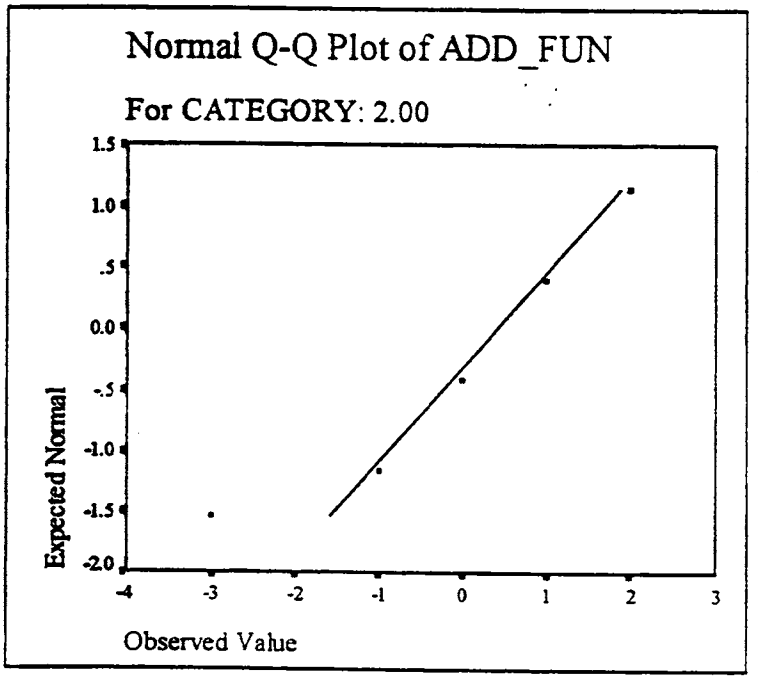
Figure K-2 (continued). EXAMPLE OF NORMALLY DISTRIBUTED MEASURE WHERE: NPPLOTS support Shapiro-Wilks statistic, because they show only one extreme deviation.

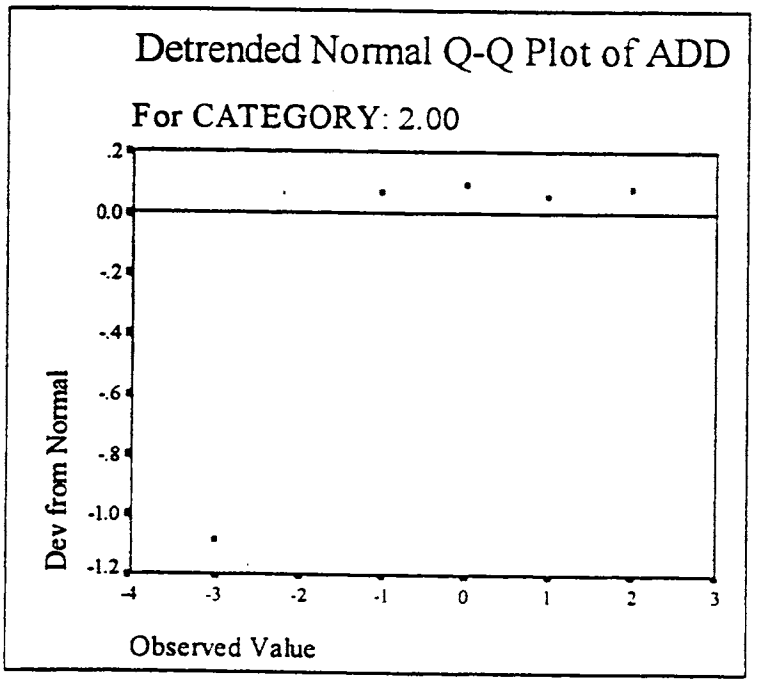




	Statistic	df	Significance	
Shapiro-Wilks	.8942	15	.0829	
K-S (Lilliefors)	.2295	15	.0325	(sample from community support category)

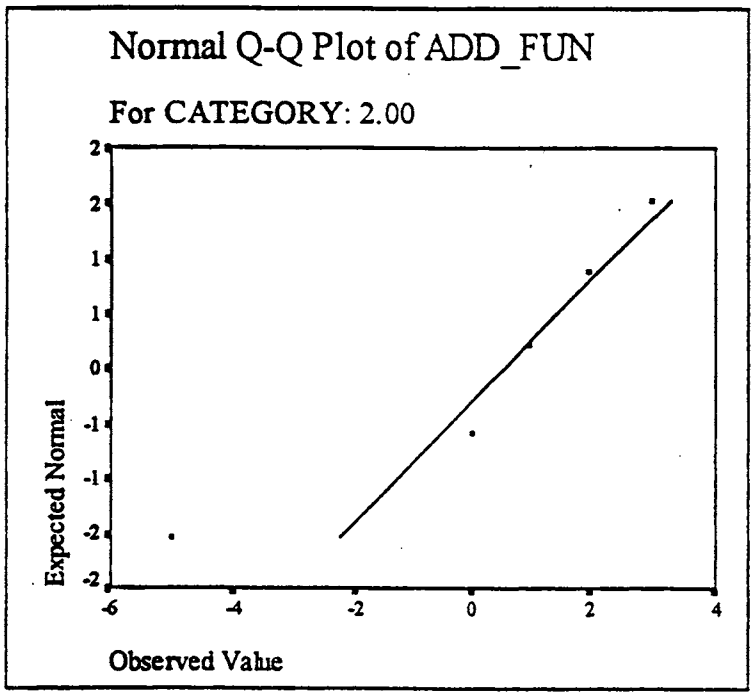
Figure K-2 (continued).
EXAMPLE OF "CONFLICTING STATISTICS/BORDERLINE NORMAL" WHERE:
NPPLOTS show one extreme deviation from normal (in direction of the skew).

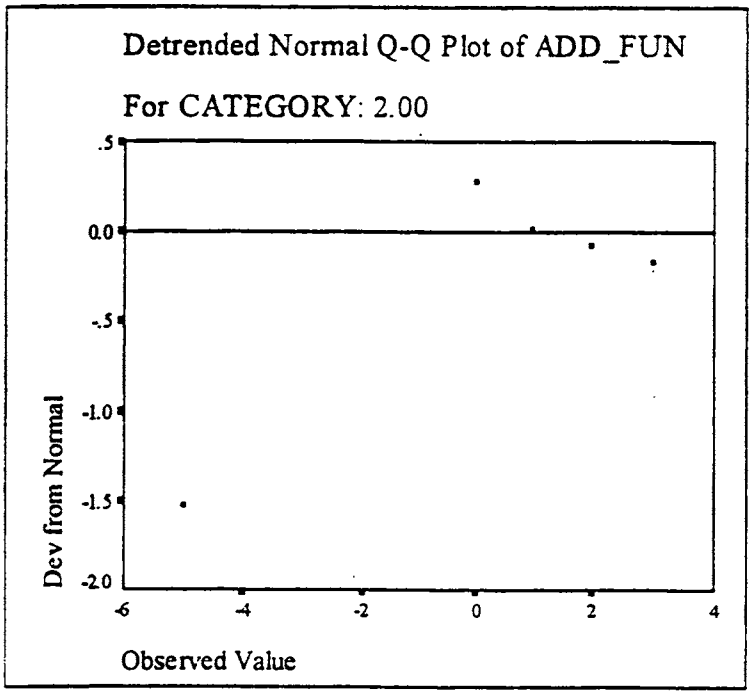




	Statistic	df	Significance	
Shapiro-Wilks	.8648	15	.0313	
K-S (Lilliefors)	.1543	15	> .2000	(sample from 10 percent error level)

Figure K-2 (continued). EXAMPLE OF CONFLICTING STATISTICS WHERE: NPPLOT shows decreasing deviations which are slightly skewed away from one extreme value.



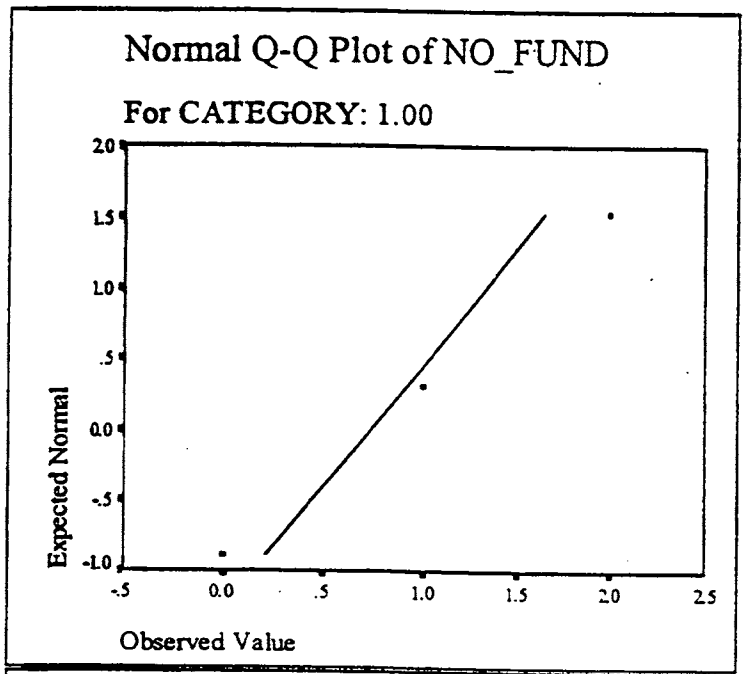


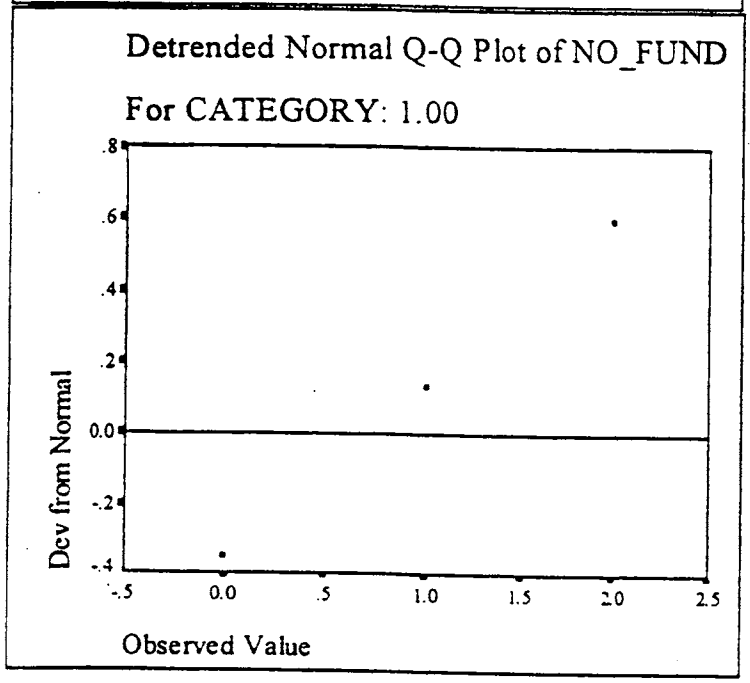
	Statistic	df	Significance
Shapiro-Wilks	.7647	15	< .0100
K-S (Lilliefors)	.1419	15	> .2000

(sample taken from 15 percent error level).

Figure K-3. Non-Normal Distribution Examples

EXAMPLE OF NON-NORMALITY WHERE:
Only three unique values {0,1,2} and NPPLOTS show increasing deviations from normal.



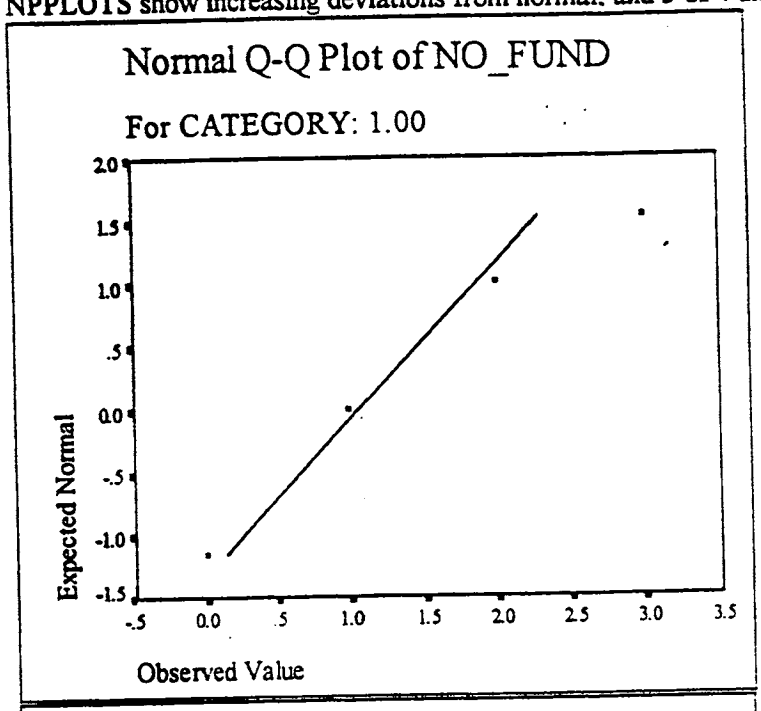


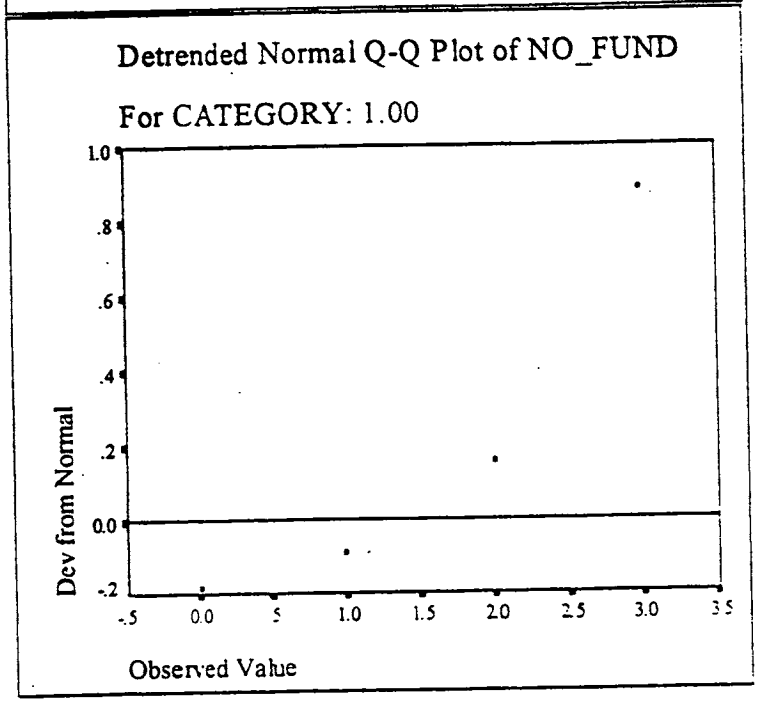
	Statistic	df	Significance
Shapiro-Wilks	.7582	15	< .0100
K-S (Lilliefors)	.2600	15	.0074

(sample from 10 percent error level)

Figure K-3 (continued). Non-Normal Distribution Examples

EXAMPLE OF NON-NORMAL LEPTOKURTIC DISTRIBUTION WHERE:
NPPLOTS show increasing deviations from normal, and 3 of 4 unique values are extremes.

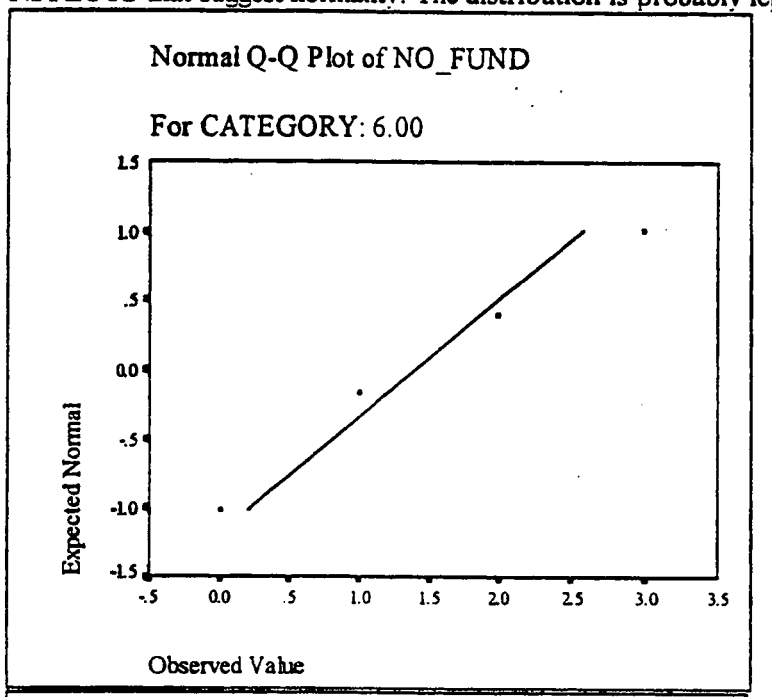


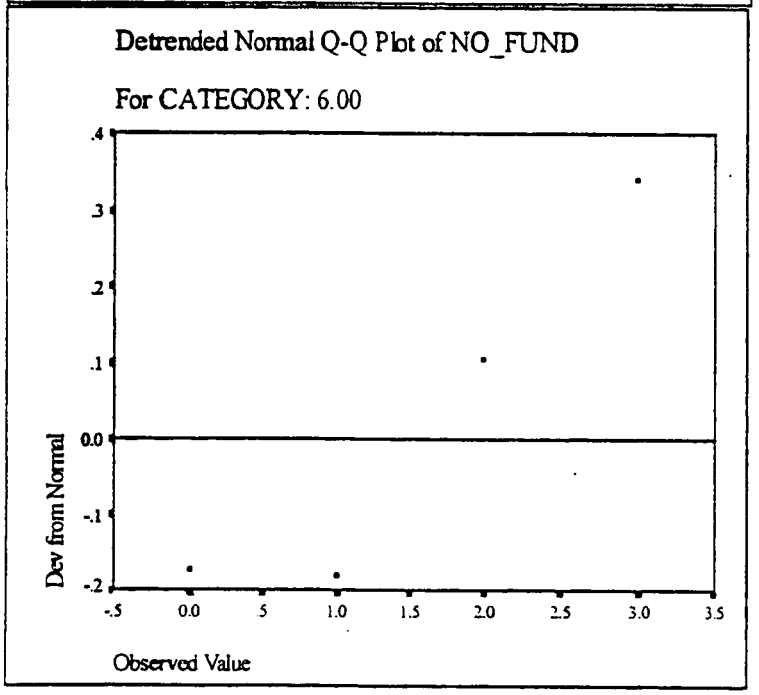


	Statistic	df	Significance
Shapiro-Wilks	.8174	15	< .0100
K-S (Lilliefors)	.3333	15	.0001

Figure K-3 (continued). *Non-Normal Distribution Examples*

EXAMPLE OF STATISTICS THAT REJECT NORMALITY Ho, AND NPPLOTS that suggest normality. The distribution is probably leptokurtic about the median (=1).



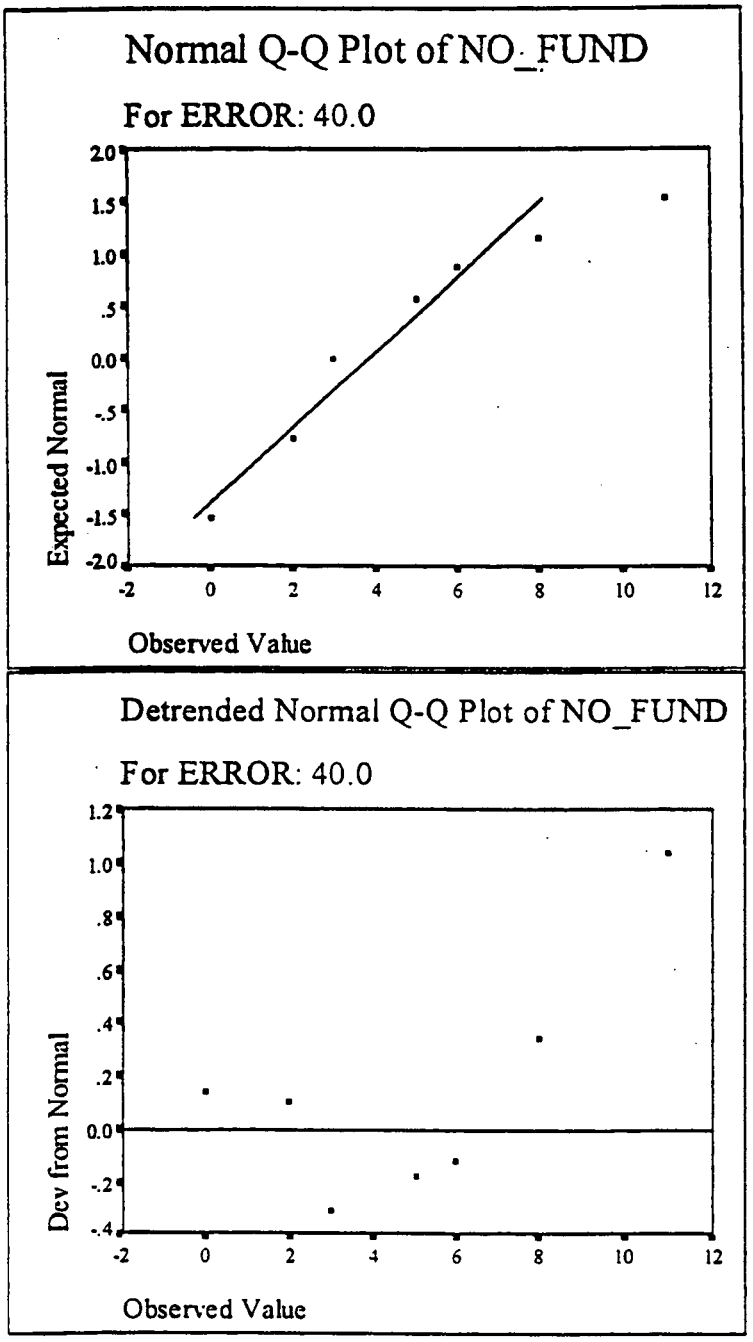


	Statistic	df	Significance
Shapiro-Wilks	.8493	15	.0172
K-S (Lilliefors)	.2323	15	.0286

(sample taken from 30 percent error level).

Figure K-3 (continued). Non-Normal Distribution Examples

EXAMPLE OF NON-NORMALITY WHERE:
Distribution could be platykurtic because of outliers seen in boxplot (see summary statistics).



	Statistic	df	Significance
Shapiro-Wilks	.8570	15	.0223
K-S (Lilliefors)	.2893	15	.0014

(sample taken from cost-efficiency category).

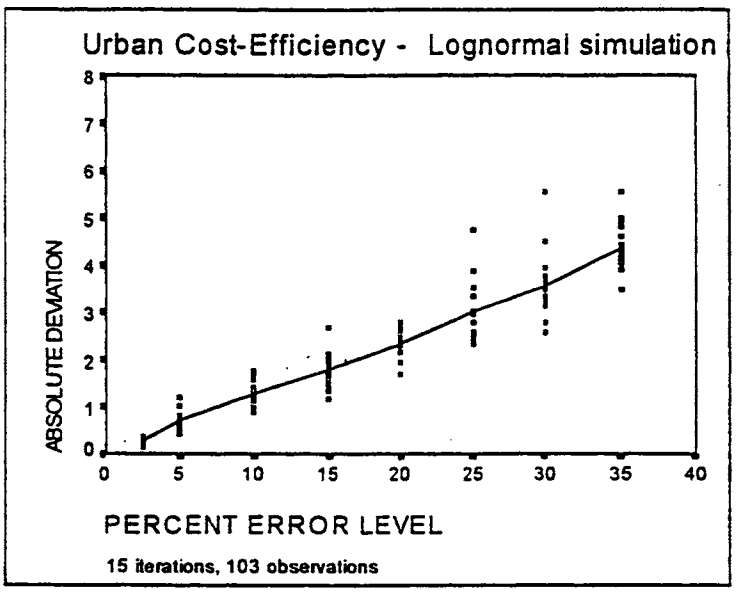
APPENDIX L. PRELIMINARY SIMULATION RESULTS FROM URBAN SUB-PROGRAM

Contents:

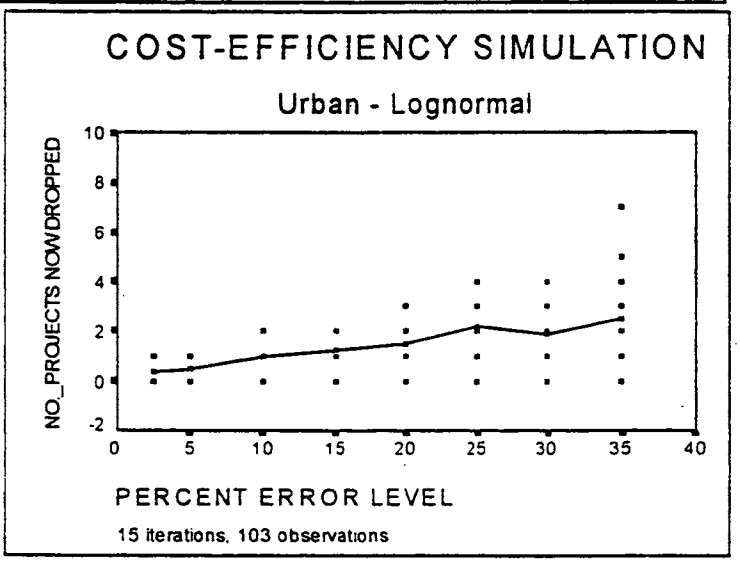
Simulation output charts for error applied in two criteria categories:

1. Cost-efficiency.
2. Community support.

A.



B.



C.

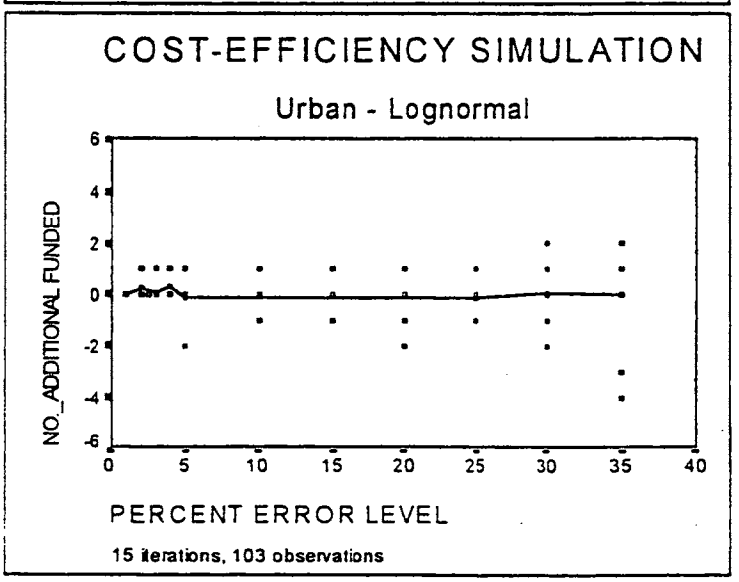
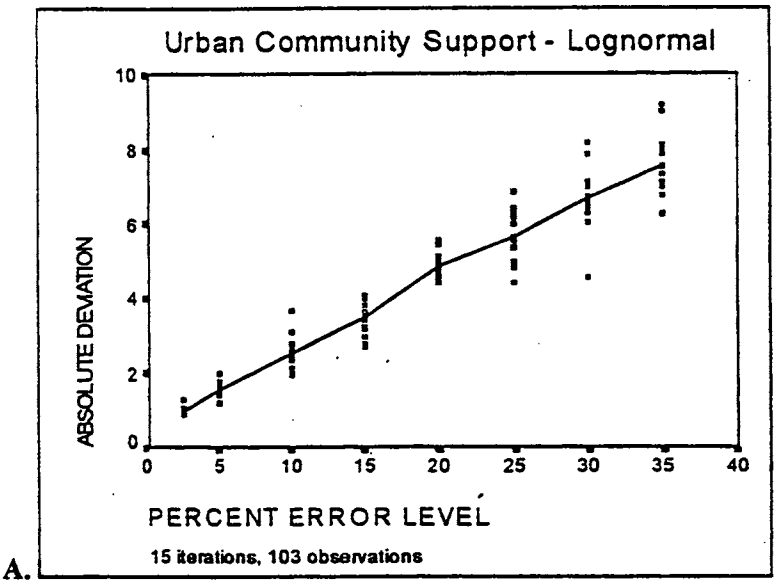
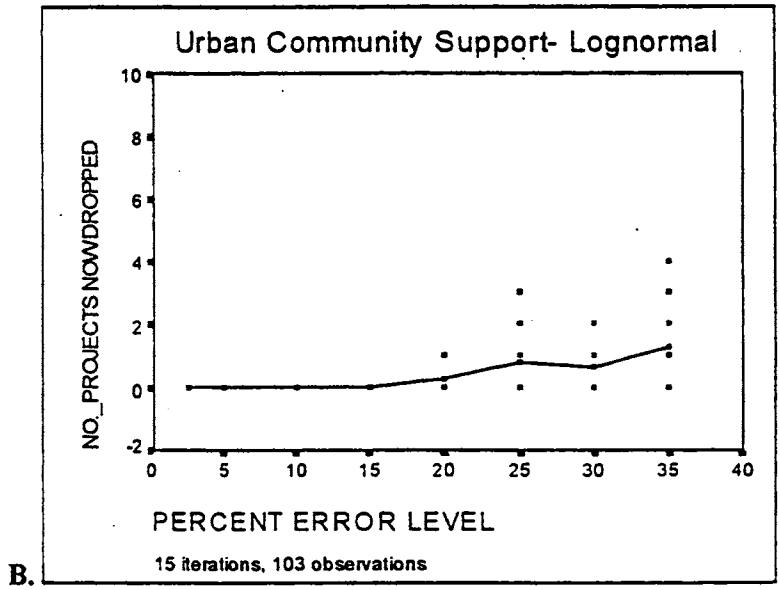


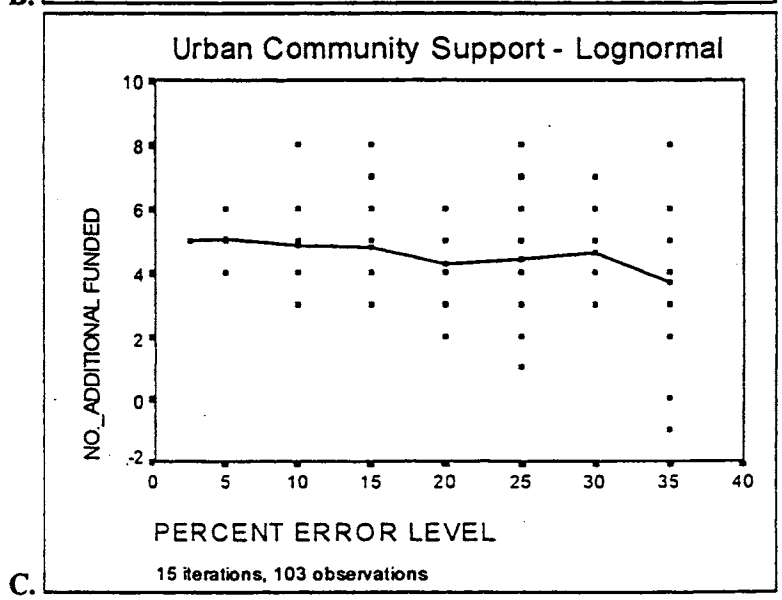
Figure L-1. Urban Cost-Efficiency Result Series



A.



B.



C.

Figure L-2. Urban Community Support Result Series