

SHRP-P-684

**Early Analyses of LTPP
General Pavement Studies Data:
Data Processing and Evaluation**

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Strategic Highway Research Program
National Research Council
Washington, DC 1994

SHRP-P-684
Contract P-020
Product No.: 5000

Program Manager: *Neil F. Hawks*
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May 1994

key words:
biases in data
correlation of variables
data
data analysis
statistical evaluation of data

Strategic Highway Research Program
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Washington, DC 20418

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Acknowledgements

The research described herein was supported by the Strategic Highway Research Program (SHRP). SHRP is a unit of the National Research Council that was authorized by section 128 of the Surface Transportation and Uniform Relocation Assistance Act of 1987.

We wish to acknowledge the valuable review, discussion, and suggestions by the Expert Task Group on Experimental Design and Analysis, the Pavement Performance Advisory Committee, SHRP staff and SHRP Contract P-001 staff. The many technical memoranda developed by Contract P-001 staff were also especially valuable.

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Abstract

The purpose of this volume is to provide statistical data that may be used to characterize the nature of the data in the various data sets. The specific data sets are the GPS-1, GPS-2, GPS-3, GPS-4, and GPS-5 data. Data was obtained from the LTPP Data Base (also referred to as the "LTPP Information Management System").

Executive Summary

The purpose of this report is to provide statistical data that may be used to characterize the nature of the data in the various data sets. The specific data sets are the General Pavement Studies (GPS)-1, GPS-2, GPS-3, GPS-4, and GPS-5 data. The actual data evaluations on the various data sets used in the analyses are described in Chapters 5 and 6 of Report SHRP-P-393, Early Analyses of LTPP General Pavement Studies Data, Sensitivity Analyses for Selected Pavement Distresses.

All of the data collected for Long Term Pavement Performance (LTPP) studies are for test sections 500 feet (152.4 meters) in length and the width of the outside traffic lane. All test sections are located in the outside traffic. Data on these test sections were downloaded from the LTPP Data Base (sometimes referred to as the "LTPP Information Management System"). Data obtained directly from the individual Strategic Highway Research Program (SHRP) Regions were estimates of initial Pavement Serviceability Index (PSI) and 18-kip (80kN) Equivalent Single Axle Loads (ESALs) by the individual State Highway Agencies, and current values of International Roughness Index (IRI) and slope variance from monitoring.

In general, the statistical data for the various data sets (one chapter for each) include the following:

1. A table that provides statistical data on the distresses observed on the test sections included in the data set. These statistical data include numbers of test sections displaying the distress of interest and the mean, standard deviation, low value, median value, high value, and range for the distress measurements.
2. Statistical data for those variables identified by a panel of experts as significant to the occurrence of distress of various types. This table includes the same data elements described in Item 1 above.
3. The output from correlation analyses for the significant variables in the hot-mix asphalt concrete (HMAC) pavement data sets, and a table describing the variables appearing in the correlation matrix and identified by brief codes. The output of these tables (see Table 2.4 as an example) have 3 values for each pair of variables analyzed. The top number is the correlation coefficient, for which 1.0 represents perfect correlation. The number just below is the probability that the correlation is not significant. The bottom number is the number of observations, i.e., the number of test sections with both of the data elements in the data set. The output from correlation analyses for the

portland cement concrete (PCC) pavement data sets, have only one number for each pair of variables. This value is the correlation coefficient for that pair of variables.

4. A frequency table by environmental region in Statistical Analysis System® (SAS) format.
5. Scatter plots for selected distresses of interest, plotted against significant independent variables.
6. Numerous distribution plots, boxplots, probability density plots, and normal quantile-quantile plots for both distresses and the more significant independent variables.
7. The appropriate sampling template for each GPS experiment with numbers of test sections in each cell indicated.

There will be a minimum of text in the beginning of each chapter to provide information specific to that particular set of statistical data. It may be convenient to review the list of figures in order to identify what scatter plots and distribution plots have been included and where within the report they are included.

Introduction

This report, due to the diversity of the research works and the bulk of the text required to describe them, has been produced in four reports and an Executive Summary. The overall report is entitled "Early Analyses of LTPP General Pavement Studies Data", but each of the individual reports has an additional title as follows:

SHRP-P-392 - Executive Summary

SHRP-P-684 - Data Processing and Evaluation

SHRP-P-393 - Sensitivity Analyses for Selected Pavement Distresses

SHRP-P-394 - Evaluation of the AASHTO Design Equations and Recommended Improvements

SHRP-P-680 - Lessons Learned and Recommendations for Future Analyses of LTPP Data

Each report is written as a "stand alone" document, but it will be useful to refer to the other reports for additional detail.

This document (SHRP-P-684) reports the results from statistical evaluations of Long-Term Pavement Performance (LTPP) data for Strategic Highway Research Program (SHRP) Contract P-020, "Data Analysis", which served as the primary vehicle for harvesting the results from the first five years of the SHRP LTPP studies and transforming this new information into implementable products supporting the LTPP goal and objectives. The research was conducted by Brent Rauhut Engineering Inc. and ERES Consultants, Inc.

The goal for the LTPP Studies, as stated in "Strategic Highway Research Plans", May 1986, is:

"To increase pavement life by investigation of various designs of pavement structures and rehabilitated pavement structures, using different materials and under different loads, environments, subgrade soil and maintenance practices."

LTPP Objectives and Expected Products

The following six objectives were established by the SHRP Pavement Performance Advisory Committee in 1985 to contribute to accomplishment of the overall goal:

1. Evaluate existing design methods.
2. Develop improved design methods and strategies for pavement rehabilitation.
3. Develop improved design equations for new and reconstructed pavements.
4. Determine the effects of: (a) loading, (b) environment, (c) material properties and variability, (d) construction quality, and (e) maintenance levels on pavement distress and performance.
5. Determine the effects of specific design features on pavement performance.
6. Establish a national long-term pavement data base to support SHRP objectives and future needs.

This research was the first to utilize the National Pavement Data Base (later renamed the "LTPP Data Base") to pursue the other objectives. The early products that were expected from this data analysis are listed below and related to project tasks (to be described later):

1. A better understanding of the effects of a broad range of loading, design, environmental, materials, construction and maintenance variables on pavement performance [Task 2].
2. Evaluation of and improvements to the models included in the 1986 AASHTO Pavement Design Guide [Tasks 3 and 4].
3. Evaluation and Improvement of AASHTO overlay design procedures using data from the General Pavement Studies (GPS) [Task 5].
4. Data analysis plans for future analyses as time-sequence data for the GPS and Specific Pavement Studies (SPS) data enter the LTPP Data Base and the LTPP Traffic Data Base to offer opportunities for further insight and design improvements [Task 6].

This project began with development of tentative analysis plans for this initial analytical effort. These plans were presented July 31, 1990 to the SHRP Expert Task Group on Experimental Design and Analysis, and on August 2, 1990 to the highway community in a SHRP Data Analysis workshop. A detailed work plan was developed from the initial plans, in consideration of comments and guidance received from these and subsequent meetings. Guidance was furnished to the contractors throughout the research by a Data Analysis Working Group (composed of SHRP Staff and SHRP Contractors), the Expert Task Group on Experiment Design and Analysis, and the Pavement Performance Advisory Committee.

Research Tasks

The specified tasks for SHRP Contract P-020a were:

- Task 1 - Data Evaluation Procedure and Workshop
- Task 1A - Data Processing and Evaluation
- Task 2 - Sensitivity Analysis of Explanatory Variables in the National Pavement Performance Data Base
- Task 3 - Evaluation of the AASHTO Design Equations
- Task 4 - Improvement of the AASHTO Design Equations
- Task 5 - Evaluate and Improve AASHTO Overlay Procedures Using GPS Data
- Task 6 - Future LTPP Data Analysis Plans

The relationships between the tasks and the general flow of the research appear in Figure 1.1. The task documented in this report is Task 1A. As can be seen, this task provided data and information needed for the remaining tasks.

Data Bases Used in the Analyses

The LTPP Data Base will eventually include data for both General Pavement Studies (GPS) and Specific Pavement Studies (SPS), but only the GPS data was marginally adequate for these early analyses. At the time analysis was initiated (Spring of 1992), the SPS data was only beginning to be entered into the IMS for projects recently constructed, and most of the projects are not yet constructed. It should be noted that all of the data collected for LTPP studies are for test sections 500 feet (152.4 meters) in length and the width of the outside traffic lane. All test sections are located in the outside traffic lane.

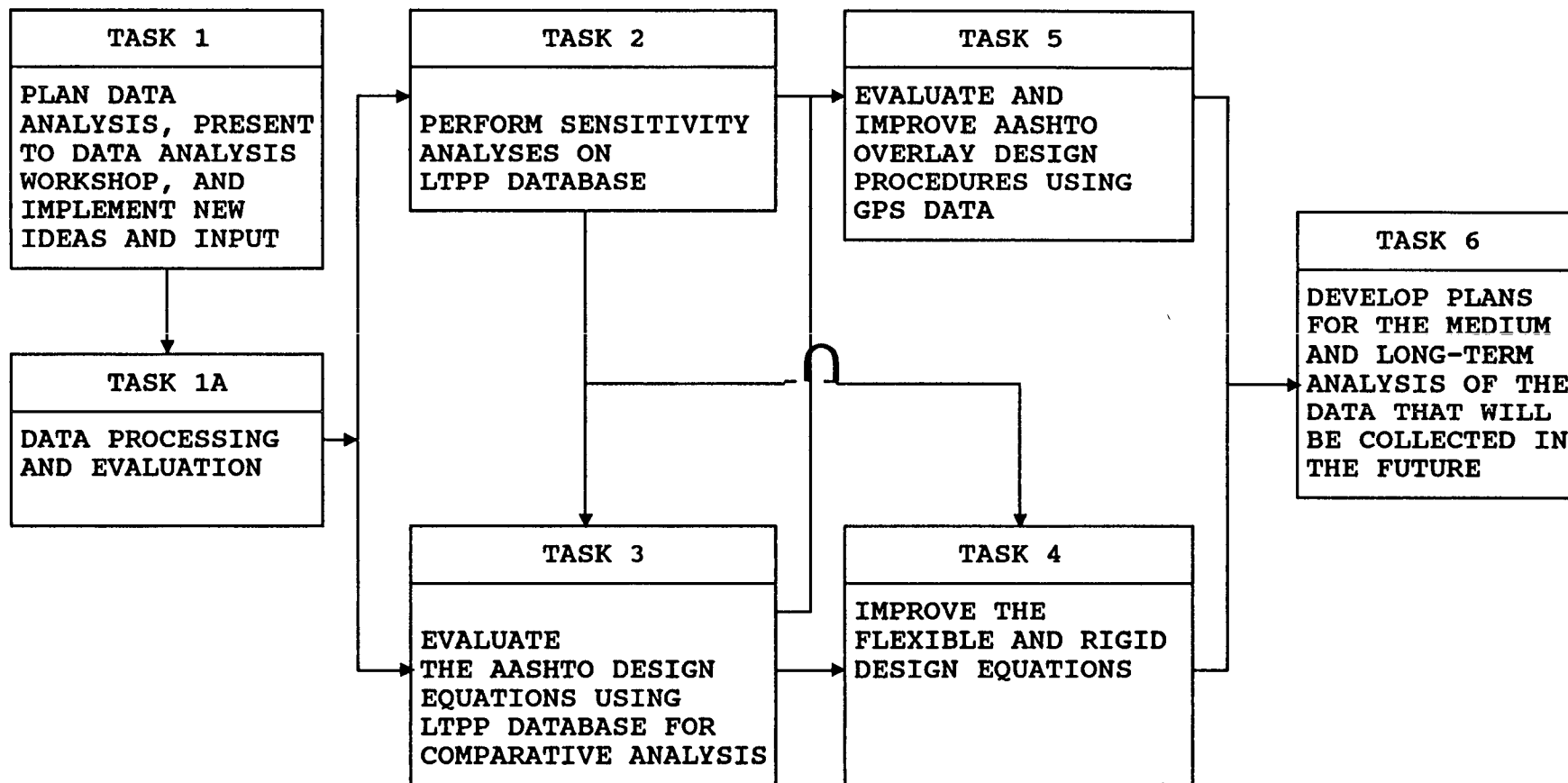


Figure 1.1 General Task Flow Diagram

The GPS experiments are identified and briefly described in Table 1.1. The sensitivity analyses were conducted only for the five data sets for pavements that had not yet been rehabilitated; i.e., were in their first service period before being overlaid or otherwise rehabilitated (GPS-1 through GPS-5). The limited data bases available for the pavements with overlays were used for Task 5, "Evaluate and Improve AASHTO Overlay Procedures Using GPS Data" (see SHRP-P-394, Early Analyses of LTPP General Pavement Studies Data, Evaluation of the AASHTO Design Equations and Recommended Results). There were not sufficient test sections in GPS-6, GPS-7, and GPS-9, for which condition prior to overlay was known, to support development of reasonable predictive models for conducting sensitivity analyses.

It should be noted that some statisticians prefer to call the GPS experimental factorials "sampling templates" rather than experimental factorials, because existing in-service pavements were used instead of test sections that were constructed to satisfy rigorous experiment designs. Instead, the factorials were established to encourage reasonable distributions of parameters expected to be significant and test sections were sought to meet the factorial requirements. The SPS will in fact follow the requirements of designed experiments.

Table 1.1 Listing of SHRP LTPP General Pavement Studies (GPS) Experiments

GPS Experiment Number	Brief Description	No. of Projects in the Data Base
1	Asphalt Concrete Pavement with Granular Base	253
2	Asphalt Concrete Pavement with Bound Base	133
3	Jointed Plain Concrete Pavement (JPCP)	126
4	Jointed Reinforced Concrete Pavement (JRCP)	71
5	Continuously Reinforced Concrete Pavement (CRCP)	85
6A	AC Overlay of AC Pavement (Prior Condition Unknown)	61
6B	AC Overlay of AC Pavement (Prior Condition Known)	31
7A	AC Overlay of Concrete Pavement (Prior Condition Unknown)	34
7B	AC Overlay of Concrete Pavement (Prior Condition Known)	15
9	Unbonded PCC Overlays of Concrete Pavement	28

Data Processing for Flexible Pavements

The bulk of the GPS-1 and GPS-2 data available was downloaded from the LTPP Data Base (sometimes referred to as the "LTPP Information Management System"). Data obtained directly from the individual SHRP Regions were estimates of initial Pavement Serviceability Index (PSI) and 18-kip (80kN) Equivalent Single Axle Loads (ESALs) by the individual State Highway Agencies, and current values of International Roughness Index (IRI) and slope variance from monitoring. These data were located in a great number of files, which could not be used directly for the data analyses. Data was extracted from these files and processed into separate data bases by data type. At this stage, separate data bases were not available for the separate GPS experiments.

The data was then extracted by experiment and combined into one data base for the statistical studies addressed in this volume. The data was sorted for the sensitivity analyses on the flexible pavements according to 12 categories of pavement structures, all from the GPS-1 and GPS-2 data. These 12 categories of pavement structures are listed in Table 1.2, along with identification of total numbers of section with sufficient data for use in the analyses and by numbers of test sections with each of the three distress types for which sensitivity analyses were conducted.

The data base to be used for the evaluation of the AASHTO Design Equation for Flexible Pavements included all of GPS-1 and GPS-2 test sections for which the pertinent data was available. The required data elements included the layer structure, the traffic data, and the performance data. Data for individual layers in the pavement structure were used, as discussed further in Volume 4, to calculate structural numbers for each test section according to AASHTO guidelines. Performance data (slope variance and rut depth) were combined to calculate PSI, utilizing the equation developed for this purpose at the AASHTO Road Test. Traffic data included in this particular data set were limited to the cumulative 18-kip (80kN) ESAL data utilized in the sensitivity analyses. These data elements, along with subgrade and environmental data (where available), were incorporated into a spreadsheet for processing and handling and finally translated to a SAS data set for analysis in SAS.

The processing of the data for use in analyses also included using the data to calculate a number of variables needed. These calculated variables included air voids in HMAC, initial IRI, change in IRI, and cumulative ESALs. Rut depths were calculated from transverse profile data, using software developed by the Texas Research and Development Foundation, on either a four-foot or six-foot straight edge basis. Four-foot (1.22 meters) values were used for evaluation of the AASHTO design equation and six-foot (1.83 meters) values for the sensitivity analyses.

Table 1.2. Categories of Pavement Structures in GPS-1/GPS-2 Data Pool and Numbers of Test Sections for Which Data are Available

Category of Pavement Structure	Total Test Sections Based on Inventory Data	Total Test Sections Based on Available Data	Test Sections with Data for		
			Rutting	Roughness	Transverse Cracking
1. HMAC on Granular Base	218	202	152	108	85
2. HMAC on Asphalt Treated Base (ATB) and Granular Base	11	2	2	2	2
3. Full Depth HMAC With Unstabilized Subgrade	52	50	46	33	22
4. Full Depth HMAC With Lime Stabilized Subgrade	7	14	14	12	6
5. Full Depth HMAC With Cement Stabilized Subgrade	3	1	1	1	0
6. HMAC Over ATB Base With Unstabilized Subgrade	18	27	17	21	8
7. HMAC Over ATB Base With Lime Stabilized Subgrade	3	3	3	2	0
8. HMAC Over ATB Base With Cement Stabilized Subgrade	1	0	0	0	0
9. HMAC with Soil Cement Base	20	16	11	5	8
10. HMAC with Lean Concrete Base	4	6	5	5	4
11. HMAC with Cement Aggregate Mixture Base	40	38	31	26	23
12. HMAC with Pozzolanic Aggregate Mixture Base	2	1	1	0	0
TOTALS	379	360	283	215	158

Data Processing for Rigid and Overlaid Pavements

BRE staff downloaded the bulk of the GPS-3, GPS-4, GPS-5, GPS-6, GPS-7, and GPS-9 data, sorted by experiment and data type, from the LTPP Data Base. Estimates of initial PSI, current values of IRI and slope variance from monitoring, and estimates of cumulative traffic were obtained from the individual SHRP regions and sorted by experiment. The data sets were then furnished to ERES for their use in the analyses for rigid and overlaid pavements.

For this study, the data from the different files were used to create several data bases for the analyses conducted. Databases were required for the following studies:

- development of distress prediction models for sensitivity analyses,
- evaluation of the AASHTO rigid pavement design equation, and
- evaluation of the revised AASHTO pavement overlay design procedures.

The processing of the data from the different files basically comprised of merging the data into the appropriate databases. In addition, several new variables computed from several of the variables in the original data files were also obtained for these databases. Initially, six databases were obtained for the GPS-3, GPS-4, GPS-5, GPS-6, GPS-7, and GPS-9 experiments using this process.

There were insufficient test sections in the GPS 6, 7, and 9 experiments for development of distress prediction models for those pavement types; therefore, these pavement sections were not included in the data base for the sensitivity analyses. Since the data for these overlaid sections are also not appropriate for the evaluation of the AASHTO rigid pavement design equation, they could only be used for the evaluation of the revised AASHTO pavement overlay design procedures.

In view of this unique use of the data for the pavements with overlays, the databases for these test sections were combined into a single database. The combined database contained complete information for a total of 20 pavements with overlays, comprised of nine GPS-6 pavements, five GPS-7 pavements, and six GPS-9 sections. This combined database was used for the evaluation of the revised AASHTO pavement overlay design procedures. Detailed information on each of the pavement sections in this limited database is presented in Chapter 8 and Appendix C of SHRP-P-394, Early Analyses of LTPP General Pavement Studies Data, Evaluation of the AASHTO Design Equations and Recommended Results. Consequently, no further information is provided on this database in this volume.

The results presented in this volume are from an initial analysis of the data for the GPS-3, 4, and 5 pavement sections that were used for the sensitivity analysis and the evaluation of the AASHTO rigid pavement design equation. Table 1.3 shows the categories of pavement structures that were available in this pool, and the number of test sections in each category that had data available for use in the sensitivity analyses for the four key distress types studied.

Table 1.3 Categories of Pavement Structures in GPS 3, 4, and 5 Data Pool and Numbers of Test Sections for Which Data are Available

Category of Pavement Structure	Total Number of Test Section Based on Inventory Data	Total Number of Test Sections Based on Available Data	Number of Test Sections with Data for Distress Types			
			Joint Faulting	Joint Spalling	Transverse Cracking	Roughness
1. JPCP	128	128	76	118	117	104
2. JRCP	71	71	32	63	54	70
3. CRCP	86	86	—	—	—	82

The database for the evaluation of the AASHTO rigid pavement design equation was also assembled from this pool. However, only the data that included information pertinent to the evaluation were included. A spreadsheet containing information on the test sections and corresponding data that were used in the evaluation is presented in Volume 3.

Statistical Data

The data evaluations conducted on the various data sets used for analyses are described in Chapters 5 and 6 of SHRP-P-393, Early Analyses of LTPP General Pavement Studies Data, Sensitivity Analyses for Selected Pavement Distresses. The purpose of this report is to provide statistical data that may be used to characterize the nature of the data in the various data sets. These specific data sets are the GPS-1, GPS-2, GPS-3, GPS-4, and GPS-5 data.

In general, the statistical data for the various data sets (one chapter for each) include the following:

1. A table that provides statistical data on the distresses observed on the test sections included in the data set. These statistical data include numbers of test sections displaying the distress of interest and the mean, standard deviation, low value, median value, high value, and range for the distress measurements.
2. Statistical data for those variables identified by a panel of experts as significant to the occurrence of distress of various types. This table includes the same data elements described in Item 1 above.
3. The output from correlation analyses for the significant variables in the HMA pavement data sets, and a table describing the variables (see Table 2.3) appearing in the correlation matrix and identified by brief codes. The output in these tables (see Table 2.4 as an example) have 3 values for each pair of variables analyzed. The top number is the correlation coefficient, for which 1.0 represents perfect correlation. The number just below is the probability that the correlation is not significant. The bottom number is the number of observations; i.e., the number of test sections with both of the data elements in the data set. The output from correlation analyses for the PCC pavements have only one number for each pair of variables. This value is the correlation coefficient for that pair of variables.
4. A frequency table by environmental region in SAS™ format.
5. Scatter plots for selected distresses of interest, plotted against significant independent variables.

6. Numerous distribution plots, boxplots, probability density plots, and normal quantile-quantile plots for both distresses and the more significant independent variables.
7. The appropriate sampling template for the experiment, with numbers of test sections in each cell indicated.

There will be a minimum of text in the beginning of each chapter to provide information specific to that particular set of statistical data. It may be convenient to review the list of figures in order to identify what scatter plots and distribution plots have been included and where within the report they are included.

Metric Conversion Factors

It was decided to simply provide a table of conversion factors from English to metric units, because of the hundreds of figures and tables. These factors appear in Table 1.4.

Table 1.4 Metric Conversion Factors
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	25	millimeters	mm
ft	feet	.30	meters	m
yd	yards	0.91	meters	m
mi	miles	1.6	kilometers	km
AREA				
in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.84	square meters	m ²
mi ²	square miles	2.6	square kilometers	km ²
	acres	0.4	hectares	ha
MASS (weight)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2,000 lb)	0.9	tonnes	t
VOLUME				
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
ft ³	cubic feet	0.03	cubic meters	m ³
yd ³	cubic yards	0.76	cubic meters	m ³
TEMPERATURE (ex-				
°F	Fahrenheit	5/9 (temperature -32)	Celsius	°C
FORCE				
lb	pound	0.14	Newton	N
k	kip	4.45	kiloNewton	kN
VISCOSITY				
	poise	0.1	Pascal second	Pa.s
STRESS				
psi	pound/square inch	6.89	kiloPascal	kPa
pci	pound/cubic inch	8.44	kiloPascal/meter	kPa/m

Statistical Data for the GPS-1 Test Sections in the LTPP Data Base

This chapter provides statistical data for the 245 GPS-1 test sections for which data were available in the LTPP Data Base at the time it was downloaded. See the section entitled "Statistical Data" in Chapter 1 for description of statistical data for the following tables and figures.

Figure 2.1 illustrates the experimental design of GPS-1. Figure 2.2 shows the moisture and temperature definitions and other design factors are summarized below:

Traffic rate:	Low - Less than or equal to 85 KESALs/Yr. High - Greater than 85 KESALs/Yr.
AC Stiffness:	Low - Less than or equal to 650 ksi (4,485 kN/m ²). High - Greater than 650 ksi (4,485 kN/m ²).
Base Thickness:	Low - Less than 10.0 in (250 mm). High - Greater than or equal to 10.0 in (250 mm).
AC Thickness:	Low - Less than 3.0 in (70 mm). Medium - 3.0 (70 mm) to 8.0 in (200 mm). High - Greater than 8.0 in (200 mm).

MOISTURE				WET										DRY									
TEMPERATURE				Freeze					No Freeze					Freeze					No Freeze				
SUBGRADE TYPE				Fine		Course		Fine		Course		Fine		Course		Fine		Course		Fine		Course	
TRAFFIC RATE				Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
AC STIFFNESS																							
BASE THICKNESS																							
AC THICKNESS																							
	Low	Low	Low			1			3	4	1	1		2	1	1		1					
			High	1				2	1	2	6						1		2				
		High	Low	1		2		1	3	2		2	1			2	2	2	1				
			High			2	1	1	1	2	2	2	1	2		1							
	Medium	Low	Low	1		2		3	3	1	2	1	1	2	1	1	2	2					
			High	4	1	2	4	2	2	2	3	3	1	2		2	1	1	1	2	2		
		High	Low	3	2	4	2	3	2	2	1	3	2	3	4		2	2	2	2			
			High	2	1	2	1	2	1	3	1	1			1	2		2	1				
High	Low	Low	2	1	4	2	2	2	2	1	1	3	1	3	1		2	3					
		High	2	3	1	2	3	1	4	1		2	2				1	1	3				
	High	Low		2	1	2		1									1		1				
		High	5	2		3	1	2									1	1					

Figure 2.1. Numbers of Test Sections for Each Cell in the GPS-1 Sampling Template

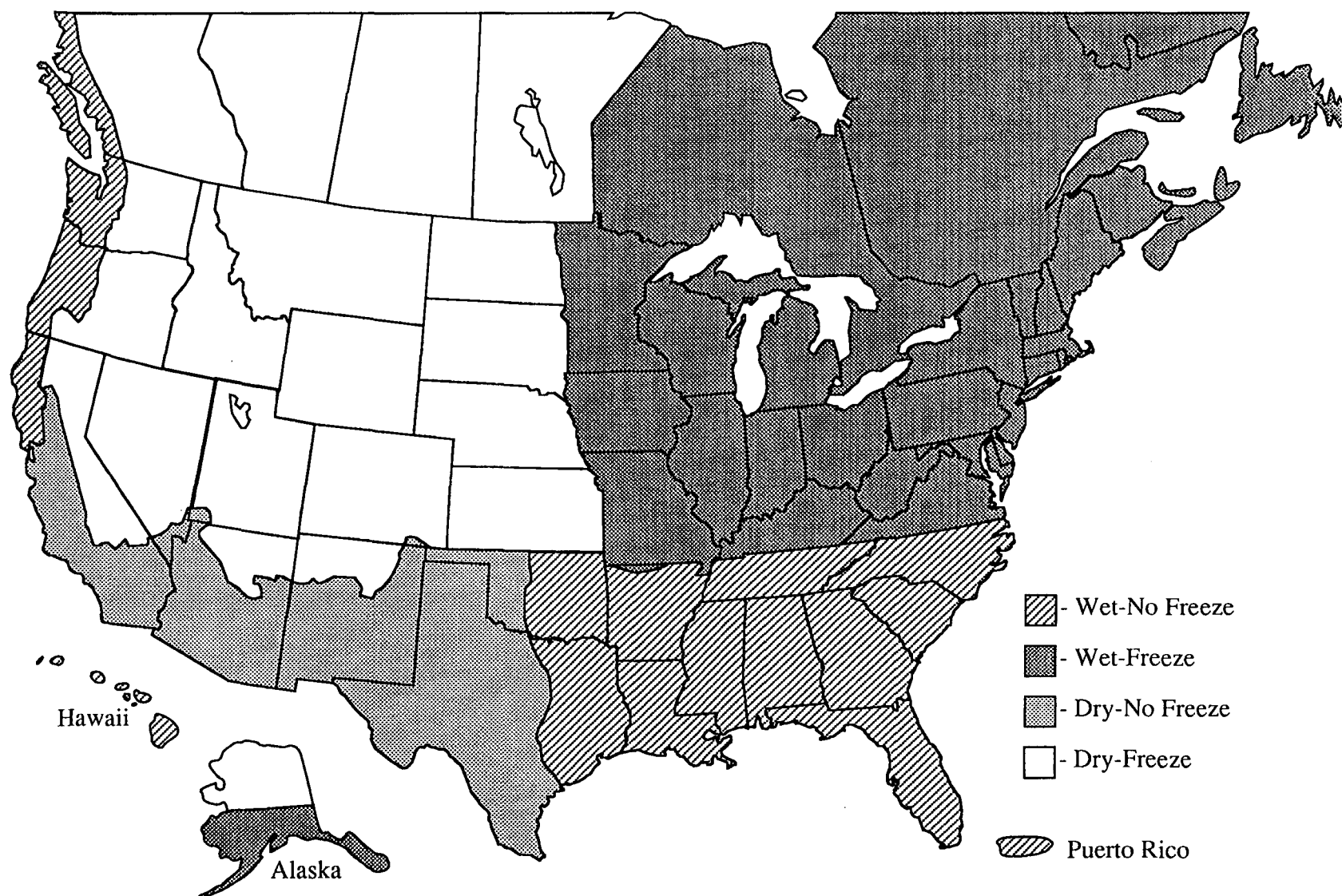


Figure 2.2. Environmental Zones for SHRP-LTPP Studies.

**Table 2.1. Various Statistical Values for Distress Variables in the GPS-1 Data Set
(246 Test Sections With Distress Data Entered in IMS)**

Variable	Units	Sections With Distress	Mean Value	Standard Deviation	Low Value	Median Value	High Value	Range
Transverse Cracking: Low Severity:	No. Cracks	133	22.1	33.8	1	9	288	287
	Lin. Ft.	129	121.8	165	1	58.5	998	997
	Moderate Severity:	No. Cracks	55	10.4	1	4	211	210
		Lin. Ft.	53	65.6	2	38.6	404	402
	High Severity:	No. Cracks	8	5.9	1	1.5	37	36
		Lin. Ft.	7	15.8	5	13.5	27	22
Alligator Cracking: Low Severity:	Square Ft.	36	780	933	4	327	3101	3097
	Moderate Severity:	Square Ft.	11	460	427	8	453	1290
		Square Ft.	1	456	0	456	456	0
Raveling & Weathering: Low Severity:	Square Ft.	17	404	1064	4	149	4500	4496
	Moderate Severity:	Square Ft.	2	32.4	28.8	12	32.4	53
		Square Ft.	0	0	0	0	0	0

Note: Statistical values only reflect data for those test sections found to have the distress of interest present.

Table 2.2. Statistical Values of Interest for Significant Variables in the GPS-1 Data Set

Variable	Units	No. of Values	Mean Value	Standard Deviation	Low Value	Median Value	High Value	Range
Rut Depth	Inches	188	0.29	0.15	0.05	0.25	0.99	0.94
Initial Roughness (IRI)	Inches/ Mile	163	57	23	14	52	123	109
Measured Roughness (IRI)	Inches/ Mile	227	87	36	36	78	260	224
Measured Friction Number	%	184	46	12	10	47	90	80
Surface Thickness	Inches	241	6.0	3.4	0.8	5.5	16.0	15.2
Granular Base Thickness	Inches	208	9.6	4.6	0.9	8.6	25.8	24.9
Granular Subbase Thickness	Inches	83	13.4	7.8	2.0	12.0	38.2	36.2
Treated Subbase Thickness	Inches	21	7.9	3.1	1.2	7.8	14.4	13.2
Age of Pavement	Years	233	9.6	5.91	1.1	9.0	25.0	24.0
Cumulative KESALS	No.	233	2176	4624	1	689	40326	40325
HMAC Asphalt Viscosity @ 140F	Poise	226	1690	951	288	1692	8422	8134
HMAC Asphalt Content	% by wt.	233	5.2	0.8	2.4	5.1	7.4	5.0
HMAC Air Voids	% by wt.	228	4.7	2.1	0.9	4.5	13.6	12.7
HMAC Aggregate Passing #4 Sieve	% by wt.	213	55.2	9.0	27.4	55.8	82.7	55.3
Comp. of Base (Mod. AASHTO)	%	163	95.0	5.7	76.4	95.2	128.3	51.9
Comp. of Subbase (Mod. AASHTO)	%	72	95.4	7.2	70	96.6	117.5	47.7
In Situ Moisture in Subgrade	%	236	11.7	6.9	0	10.9	36.0	36.0
Subgrade Soil Passing #200 Sieve	% by wt.	232	36.1	27.4	0.4	29.2	97.5	97.1

Table 2.2. Statistical Values of Interest for Significant Variables in the GPS-1 Data Set

Variable	Units	No. of Values	Mean Value	Standard Deviation	Low Value	Median Value	High Value	Range
Plasticity Index of Subgrade	%	236	6.9	9.1	0	3	44	44
Liquid Limit of Subgrade	%	236	17.2	17.7	0	15.5	72	72
Subgrade Soil Finer than 0.02mm	%	218	26.1	20.2	0.7	20.9	91.4	90.7
Freeze Index	°F-Days < 32°F	235	591	822	0	161	3396	3396
No. of Days Min. Temp. < 32°F	No.	235	91.7	65.5	0	86	236	236
No. of Days Max. Temp. > 90°F	No.	235	45.9	46.2	0	37	180	180
No. of Air Freeze-Thaw Cycles	No.	235	72.0	44.4	0	78.0	197	197
Annual Precip.	Inches	235	33.7	16.2	3.0	35.3	84.2	81.2
Average Daily Temp. Range	°F	245	23.5	4.2	13.8	23.0	35.3	21.5
Avg. Min. Temp. (Daily Min. Temps. for Dec., Jan., and Feb.)	°F	245	26.4	15.1	-6.5	26.4	67.5	74.0
Avg. Max Temp. (Daily Max. Temps. (June, July, Aug.))	°F	245	86.3	8.1	60.8	87.9	109	48.2
Avg. Min. Temp. by Month	°F	230	44.5	11.4	22.9	44.74	68.7	45.8
Avg. Max. Temp. by Month	°F	230	68.1	11.9	42.1	70.0	88.5	46.4

Table 2.3. Description of Variables Used in the Correlation Matrix for the GPS-1 Data Set

Variable	Description of Variable
MEAN6	Rut Depth (6-ft. straight edge), inches
I_IRI	Initial IRI value, inches/mile
B_IRI	Measured IRI value, inches/mile
TCRK_T	Total measured Transverse cracking (all severity levels combined) in linear feet
TNO_T	Total number of Transverse cracks identified (all severity levels combined)
AGE	Age of pavement, years
KESALs	Equivalent Single Axle Loads in thousands
SURTH	Surface thickness, inches
GBTHK	Granular Base thickness, inches
GSBTH	Granular Subbase thickness, inches
TSBTH	Treated Subbase thickness, inches
V140	Asphalt cement viscosity @ 140°F, poise
A_CON	Asphalt Content of surface course, % by weight
AV	Air Voids of surface course, % by volume
% 4	Percent Passing the #4 sieve for surface course, by weight
COMPB	Compaction of the Granular Base, % Modified AASHTO
COMPS	Compaction of the Granular Subbase, % Modified AASHTO
% 200	Percent passing the #4 sieve for the subgrade, by weight
MOIST	Insitu Moisture of the subgrade, % by weight
TPREC	Average Annual Precipitation, inches
AVG90	Average number of days with temperature greater than 90°F
AVG32	Average number of days with temperature less than 32°F
FTIN	Freeze Index, degree-days
FRZTH	Average number of Freeze-Thaw Cycles

Table 2.4. Correlation Analysis for Significant Variables in the GPS-1 Data Set (SAS Format)

Pearson Correlation Coefficients/Prob > |R| under Ho: Rho=0/Number of Observations

	MEAN6	I_IRI	B_IRI	TCRK_T	TNO_T	AGE	KESALS	SURTH	GBTHK	GSBTH	SBTHK	V140
MEAN6	1.00000 0.0 188	0.01264 0.8856 132	0.22617 0.0027 174	0.12962 0.0762 188	0.18452 0.0112 188	0.25852 0.0004 187	0.34363 0.0001 187	0.06604 0.3692 187	-0.03711 0.6466 155	0.11460 0.4185 52	-0.36672 0.1477 17	-0.04968 0.5078 180
I_IRI	0.01264 0.8856 132	1.00000 0.0 163	0.14279 0.0834 148	-0.06012 0.4473 162	-0.06662 0.3996 162	-0.0723 0.6434 157	-0.09346 0.2444 157	-0.11832 0.1362 160	0.08225 0.3305 142	-0.23191 0.0855 56	-0.19215 0.5105 14	-0.24792 0.0019 155
B_IRI	0.22617 0.0027 174	0.14279 0.0834 148	1.00000 0.0 227	0.21420 0.0012 226	0.14200 0.1329 226	0.15873 0.0205 213	-0.16558 0.0156 213	-0.06299 0.3513 221	-0.00993 0.8918 190	0.12185 0.3044 73	-0.04619 0.8467 20	-0.01076 0.8778 207
TCRK_T	0.12962 0.0762 188	-0.06012 0.4473 162	0.21420 0.0012 226	1.00000 0.0 246	0.75630 0.0001 246	0.10643 0.1059 232	-0.03283 0.6189 232	0.08269 0.2018 240	-0.13709 0.0489 207	0.04113 0.7137 82	-0.04753 0.8379 21	-0.13429 0.0442 225
TNO_T	0.18452 0.0112 188	-0.06662 0.3996 162	0.14200 0.0329 226	0.75630 0.0001 246	1.00000 0.0 246	0.07670 0.2445 232	-0.02559 0.6982 232	0.00723 0.9113 240	-0.05819 0.4049 207	0.06498 0.5619 82	-0.00108 0.9963 21	-0.11342 0.0896 225
AGE	0.25852 0.0004 187	-0.03723 0.6434 157	0.15873 0.0205 213	0.10643 0.1059 232	0.07670 0.2445 232	1.00000 0.0 233	0.20023 0.0021 233	0.08057 0.2266 227	-0.03027 0.6752 194	0.10752 0.3652 73	-0.11361 0.6239 21	-0.22162 0.0011 213
KESALS	0.34363 0.0001 187	-0.09346 0.2444 157	-0.16558 0.0156 213	-0.03283 0.6189 232	-0.02559 0.6982 232	0.20023 0.0021 233	1.00000 0.0 233	0.24740 0.0002 227	-0.10009 0.1650 194	0.23090 0.0494 73	0.24240 0.2898 21	0.04262 0.5362 213
SURTH	0.06604 0.3692 187	-0.11832 0.1362 160	-0.06299 0.3513 221	0.08269 0.2018 240	0.00723 0.9113 240	0.08057 0.2266 227	0.24740 0.0002 227	1.00000 0.0 241	-0.05123 0.4624 208	0.05194 0.6410 83	0.12007 0.6042 21	-0.03992 0.5504 226
GBTHK	-0.03711 0.6466 155	0.08225 0.3305 142	-0.00993 0.8918 190	-0.13709 0.0489 207	-0.05819 0.4049 207	-0.03027 0.6752 194	-0.10009 0.1650 194	-0.05123 0.4624 208	1.00000 0.0 208	0.10052 0.3844 77	-0.09519 0.7071 18	-0.01085 0.8800 196

Table 2.4. Correlation Analysis for Significant Variables in the GPS-1 Data Set (SAS Format)

Pearson Correlation Coefficients/Prob > |R| under Ho: Rho=0/Number of Observations

	MEAN6	I_IRI	B_IRI	TCRK_T	TNO_T	AGE	KESALS	SURTH	GBTHK	GSBTH	SBTHK	V140
GSBTH	0.11460 0.4185 52	-0.23191 0.0855 56	0.12185 0.3044 73	0.04113 0.7137 82	0.06498 0.5619 82	0.10752 0.3652 73	0.23090 0.0494 73	0.05194 0.6410 83	0.10052 0.3844 77	1.00000 0.0 83	. . 0	-0.10966 0.3457 76
TSBTH	-0.36672 0.1477 17	-0.19215 0.5105 14	-0.04619 0.8467 20	-0.04753 0.8379 21	-0.00108 0.9963 21	-0.11361 0.6239 21	0.24240 0.2898 21	0.12007 0.6042 21	-0.09519 0.7071 18	. . 0	1.00000 0.0 21	-0.18235 0.4549 19
V140	-0.04968 0.5078 180	-0.24792 0.0019 155	-0.01076 0.8778 207	-0.13429 0.0442 225	-0.11342 0.0896 225	-0.22162 0.0011 213	0.04262 0.5362 213	-0.03992 0.5504 226	-0.01085 0.8800 196	-0.10966 0.3457 76	-0.18235 0.4549 19	1.00000 0.0 226
A_CON	-0.03585 0.6290 184	0.05012 0.5357 155	-0.00598 0.9309 213	-0.00048 0.9942 233	0.00927 0.8881 233	0.00153 0.9819 222	-0.13697 0.0415 222	-0.35442 0.0001 233	0.01467 0.8363 201	0.05803 0.6162 77	-0.31165 0.1691 21	-0.07585 0.2637 219
AV	-0.24151 0.0010 184	0.09074 0.2646 153	0.09813 0.1585 208	0.02864 0.6670 228	0.01233 0.8531 228	-0.01938 0.7761 218	-0.13514 0.0463 218	-0.03190 0.6318 228	0.02132 0.7674 195	-0.06214 0.5939 76	-0.10389 0.6629 20	0.05684 0.4080 214
%4	-0.16561 0.0285 175	0.00569 0.9460 144	0.00820 0.9094 195	0.17999 0.0085 213	0.09441 0.1697 213	-0.06861 0.2171 206	-0.11880 0.0890 206	-0.22557 0.0009 213	-0.17899 0.0156 182	-0.07329 0.5436 71	-0.20487 0.4302 17	-0.02053 0.7724 201
COMPB	-0.15449 0.0829 127	-0.14771 0.1219 111	0.04939 0.5497 149	-0.04983 0.5276 163	0.01560 0.8433 163	-0.12501 0.1249 152	-0.13773 0.0906 152	-0.20641 0.0082 163	0.15422 0.0501 162	-0.28442 0.0290 59	-0.27790 0.3579 13	0.13525 0.0966 152
COMPS	-0.01525 0.9217 44	-0.07508 0.6081 49	-0.04240 0.7394 64	0.15850 0.1836 72	0.09970 0.4047 72	-0.08698 0.4943 64	-0.30954 0.0128 64	0.00466 0.9690 72	-0.16456 0.1799 68	0.06205 0.6125 69	. . 0	-0.14090 0.2591 66
%200	-0.05089 0.4963 181	0.11962 0.1408 153	0.06861 0.3201 212	0.05872 0.3743 231	0.04436 0.5023 231	-0.08566 0.2067 219	-0.09416 0.1650 219	0.18845 0.0040 232	0.04133 0.5611 200	0.06771 0.5558 78	0.21583 0.3474 21	0.00496 0.9421 217

Table 2.4. Correlation Analysis for Significant Variables in the GPS-1 Data Set (SAS Format)

Pearson Correlation Coefficients/Prob > |R| under Ho: Rho=0/Number of Observations

	MEAN6	I_IRI	B_IRI	TCRK_T	TNO_T	AGE	KESALS	SURTH	GBTHK	GSBTH	SBTHK	V140
MOIST	-0.9967 0.1783 184	0.15520 0.0530 156	0.01376 0.8407 216	0.00967 0.8827 235	0.02220 0.7349 235	-0.07704 0.2519 223	-0.11856 0.0773 223	0.13614 0.0366 236	0.11038 0.1160 204	0.05324 0.6390 80	0.03595 0.8771 21	0.06603 0.3285 221
TPREC	-0.10722 0.1531 179	-0.13802 0.0858 156	-0.02653 0.6975 217	-0.18646 0.0042 234	-0.06762 0.3030 234	-0.21071 0.0016 222	-0.20277 0.0024 222	0.01138 0.8640 229	0.17895 0.0114 199	0.14991 0.1932 77	0.25288 0.2687 21	0.13302 0.0514 215
AVG90	0.24246 0.0011 179	0.15843 0.0482 156	-0.10110 0.1377 217	-0.03796 0.5635 234	0.02501 0.7035 234	-0.00574 0.9322 222	0.37598 0.0001 222	-0.07187 0.2788 229	0.03908 0.5836 199	0.01698 0.8835 77	-0.35613 0.1131 21	0.03477 0.6122 215
AVG32	-0.09074 0.2271 179	0.02730 0.7352 156	0.09711 0.1540 217	0.22019 0.0007 234	0.07231 0.2706 234	0.15103 0.0244 222	-0.16516 0.0137 222	0.14570 0.0275 229	-0.14350 0.0432 199	0.01188 0.9184 77	0.27145 0.2339 21	-0.40189 0.0001 215
FTIN	-0.03141 0.6764 179	0.02762 0.7322 156	0.18127 0.0074 217	0.29432 0.0001 234	0.12210 0.0622 234	0.20284 0.0024 222	-0.14061 0.0363 222	0.09095 0.1702 229	-0.12375 0.0816 199	-0.03741 0.7467 77	-0.14695 0.5250 21	-0.36732 0.0001 215
FRZTH	-0.09163 0.2225 179	0.04400 0.5855 156	-0.00829 0.9033 217	0.12438 0.0574 234	0.02496 0.7040 234	0.10107 0.1333 222	-0.12643 0.0600 222	0.16114 0.0146 229	-0.13906 0.0501 199	-0.03473 0.7643 77	0.50890 0.0185 21	-0.35354 0.0001 215

Note: SAS prints out correlation matrices on wide computer paper, so the right-hand columns omitted above appear on the following pages.

Table 2.4. Correlation Analysis for Significant Variables in the GPS-1 Data Set (SAS Format)

Pearson Correlation Coefficients/Prob > |R| under Ho: Rho=0/Number of Observations

	A_CON	AV	%4	COMPB	COMPS	%200	MOIST	TPREC	AVG90	AVG32	FTIN	FRZTH
MEAN6	-0.03585 0.6290 184	-0.24151 0.0010 184	-0.16561 0.0285 175	-0.15449 0.0829 127	-0.01525 0.9217 44	-0.05089 0.4963 181	-0.09967 0.1783 184	-0.10722 0.1531 179	0.24246 0.0011 179	-0.09074 0.2271 179	-0.03141 0.6764 179	-0.09163 0.2225 179
I_IRI	0.05012 0.5357 155	0.09074 0.2646 153	0.00569 0.9460 144	-0.14771 0.1219 111	-0.07508 0.6081 49	0.11962 0.1408 153	0.15520 0.0530 156	-0.13802 0.0858 156	0.15843 0.0482 156	0.02730 0.7352 156	0.02762 0.7322 156	0.04400 0.5855 156
B_IRI	-0.00598 0.9309 213	0.09813 0.1585 208	0.00820 0.9094 195	0.04939 0.5497 149	-0.04240 0.7394 64	0.06861 0.3201 212	0.01376 0.8407 216	-0.002653 0.6975 217	-0.10110 0.1377 217	0.09711 0.1540 217	0.18127 0.0074 217	-0.00829 0.9033 217
TCRK_T	-0.00048 0.9942 233	0.02864 0.6670 228	0.17999 0.0085 213	-0.04983 0.5276 163	0.15850 0.1836 72	0.05872 0.3743 231	0.00967 0.8827 235	-0.18646 0.0042 234	-0.03796 0.5635 234	0.22019 0.0007 234	0.29432 0.0001 234	0.12438 0.0574 234
TNO_T	0.00927 0.8881 233	0.01233 0.8531 228	0.09442 0.1697 213	0.01560 0.8433 163	0.09970 0.4047 72	0.04436 0.5023 231	0.02220 0.7349 235	-0.06762 0.3030 234	0.02501 0.7035 234	0.07231 0.2706 234	0.12210 0.0622 234	0.02496 0.7040 234
AGE	0.00153 0.9819 222	-0.01938 0.7761 218	-0.06861 0.3271 206	-0.12501 0.1249 152	-0.08698 0.4943 64	-0.08566 0.2067 219	-0.07704 0.2519 223	-0.21071 0.0016 222	-0.00574 0.9322 222	0.15103 0.0244 222	0.20284 0.0024 222	0.10107 0.1333 222
KESALS	-0.13697 0.0415 222	-0.13514 0.0463 218	-0.11880 0.0890 206	-0.13773 0.0906 152	-0.30954 0.0128 64	-0.09416 0.1650 219	-0.11856 0.0773 223	-0.20277 0.0024 222	-0.37598 0.0001 222	-0.16516 0.0137 222	-0.14061 0.0363 222	-0.12643 0.0600 222
SURTH	-0.35442 0.0415 222	-0.03190 0.0463 218	-0.22557 0.0890 206	-0.20641 0.0906 152	0.00466 0.0128 64	0.18845 0.0650 219	0.13614 0.0773 223	0.01138 0.0024 222	-0.07187 0.0001 222	0.14570 0.0137 222	0.09095 0.0363 222	0.16114 0.0600 222
GBTHK	0.01467 0.8363 201	0.02132 0.7674 195	-0.17899 0.0156 182	0.15422 0.0501 162	-0.16456 0.1799 68	0.04133 0.5611 200	0.11038 0.1160 204	0.17895 0.114 199	0.03908 0.5836 199	-0.14350 0.0432 199	-0.12375 0.0816 199	-0.13906 0.0501 199

Table 2.4. Correlation Analysis for Significant Variables in the GPS-1 Data Set (SAS Format)

Pearson Correlation Coefficients/Prob > |R| under Ho: Rho=0/Number of Observations

	A_CON	AV	%4	COMPB	COMPS	%200	MOIST	TPREC	AVG90	AVG32	FTIN	FRZTH
GSBTH	0.05803 0.6162 77	-0.06214 0.5939 76	-0.07329 0.5436 71	-0.28422 0.0290 59	0.06205 0.6125 69	0.06771 0.5558 78	0.05324 0.6390 80	0.14991 0.1932 77	0.01698 0.8835 77	0.01188 0.9184 77	-0.03741 0.7467 77	-0.03473 0.7643 77
TSBTH	-0.31165 0.1691 21	-0.10389 0.6629 20	-0.20487 0.4302 17	-0.27790 0.3579 13	. . 0	0.021583 0.3474 21	0.03595 0.8771 21	0.25288 0.2687 21	-0.35613 0.1131 21	0.27145 0.2339 21	-0.14695 0.5250 21	0.50890 0.0185 21
V140	-0.07585 0.2637 219	0.05684 0.4080 214	-0.02053 0.7724 201	0.13525 0.0966 152	-0.14090 0.2591 66	0.00496 0.9421 217	0.06603 0.3285 221	0.13302 0.0514 215	0.03477 0.6122 215	-0.40189 0.0001 215	-0.36732 0.0001 215	-0.35354 0.0001 215
A_CON	1.00000 0.0 233	-0.01046 0.8755 227	0.28986 0.0001 212	-0.09659 0.2288 157	-0.10482 0.3986 67	-0.12006 0.0729 224	-0.06478 0.3302 228	-0.14068 0.0362 222	-0.03105 0.6454 222	0.00908 0.8930 222	0.02464 0.7150 222	-0.01577 0.8152 222
AV	-0.01046 0.8755 227	1.00000 0.0 228	0.08255 0.2314 212	0.05258 0.5172 154	-0.00673 0.9572 66	0.06492 0.3390 219	0.09583 0.1538 223	0.14208 0.0365 217	0.04857 0.4766 217	-0.20076 0.0030 217	-0.09011 0.1860 217	-0.24102 0.0003 217
%4	0.28986 0.0001 212	0.08255 0.2314 212	1.00000 0.0 213	0.05277 0.5285 145	0.25659 0.0407 64	-0.00151 0.9829 206	-0.05919 0.3934 210	-0.23435 0.0008 202	-0.08585 0.2244 202	0.14677 0.0371 202	0.20316 0.0037 202	0.06930 0.3271 202
COMPB	0.09659 0.2288 157	0.05258 0.5172 154	0.05277 0.5285 145	1.00000 0.0 163	0.12434 0.3524 58	0.17151 0.0312 158	0.15177 0.0546 161	0.03022 0.7081 156	-0.01261 0.8759 156	-0.12455 0.1214 156	-0.06927 0.3902 156	-0.11451 0.1546 156
COMPS	-0.10482 0.3986 67	-0.00673 0.9572 66	0.25659 0.0407 64	0.012434 0.3524 58	1.00000 0.0 72	-0.01304 0.9153 69	-0.15167 0.2067 71	-0.15863 0.1998 67	0.14036 0.2573 67	0.19895 0.1065 67	0.14605 0.2383 67	0.22800 0.0635 67
%200	-0.12006 0.0729 224	0.06492 0.3390 219	-0.00151 0.9829 206	0.17151 0.312 158	-0.01304 0.9153 69	1.00000 0.0 232	0.77266 0.0001 232	-0.07775 0.2497 221	0.09116 0.1769 221	-0.05691 0.3998 221	-0.15211 0.0237 221	0.04653 0.4913 221

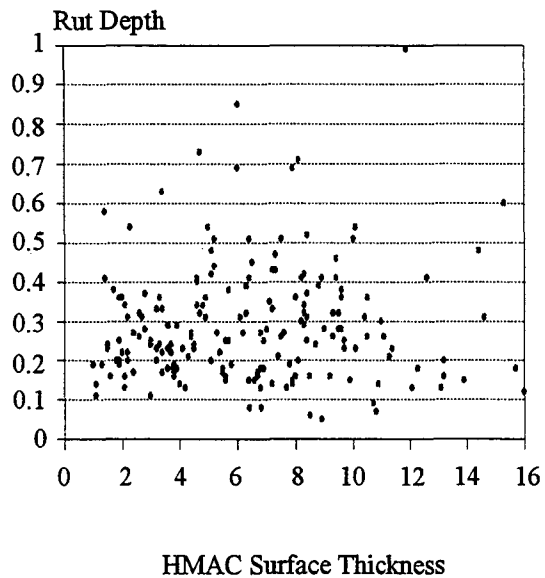
Table 2.4. Correlation Analysis for Significant Variables in the GPS-1 Data Set (SAS Format)

Pearson Correlation Coefficients/Prob > |R| under Ho: Rho=0/Number of Observations

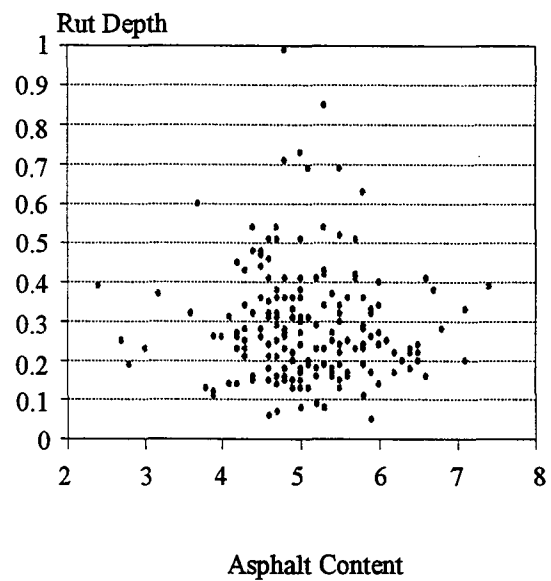
	A_CON	AV	%4	COMPB	COMPS	%200	MOIST	TPREC	AVG90	AVG32	FTIN	FRZTH
MOIST	-0.06478	0.09583	-0.05919	0.15177	-0.15167	0.77266	1.00000	0.06571	0.15925	-0.22081	-0.27890	-0.10050
	0.3302	0.1538	0.3934	0.0546	0.2067	0.0001	0.0	0.3265	0.0168	0.0009	0.0001	0.1329
	228	223	210	161	71	232	236	225	225	225	225	225
TPREC	-0.14068	0.14208	-0.23435	0.03022	-0.15863	-0.07775	0.06571	1.00000	-0.020538	-0.26274	-0.22897	-0.26476
	0.0362	0.0365	0.0008	0.7081	0.1998	0.2497	0.3265	0.0	0.0015	0.0001	0.0004	0.0001
	222	217	202	156	67	221	225	235	235	235	235	235
AVG90	-0.03105	0.04857	-0.08585	-0.01261	0.14036	0.09116	0.15925	-0.20538	1.00000	-0.72158	-0.58145	-0.62703
	0.6454	0.4766	0.2244	0.8759	0.2573	0.1769	0.0168	0.0015	0.0	0.0001	0.0001	0.0001
	222	217	202	156	67	221	225	235	235	235	235	235
AVG32	0.00908	-0.20076	0.14677	-0.12455	0.19895	-0.05691	-0.22081	-0.26274	-0.72158	1.00000	0.81817	0.88620
	0.8930	0.0030	0.0371	0.1214	0.1065	0.3998	0.0009	0.0001	0.0001	0.0	0.0001	0.0001
	222	217	202	156	67	221	225	235	235	235	235	235
FTIN	0.02464	-0.09011	0.20316	-0.06927	0.14605	-0.15211	-0.27890	-0.22897	-0.58145	0.81817	1.00000	0.47604
	0.7150	0.1860	0.0037	0.3902	0.2383	0.0237	0.0001	0.0004	0.0001	0.0001	0.0	0.0001
	222	217	202	156	67	221	225	235	235	235	235	235
FRZTH	-0.01577	-0.24102	0.06930	-0.11451	0.22800	0.04653	-0.10050	-0.26476	-0.62703	0.88620	0.476041	1.00000
	0.8152	0.0003	0.3271	0.1546	0.0635	0.4913	0.1329	0.0001	0.0001	0.0001	0.0001	0.0
	222	217	202	156	67	221	225	235	235	235	235	235

**Table 2.5. Frequency Table by Environmental Region for the GPS-1 Data Set
(SAS Format)**

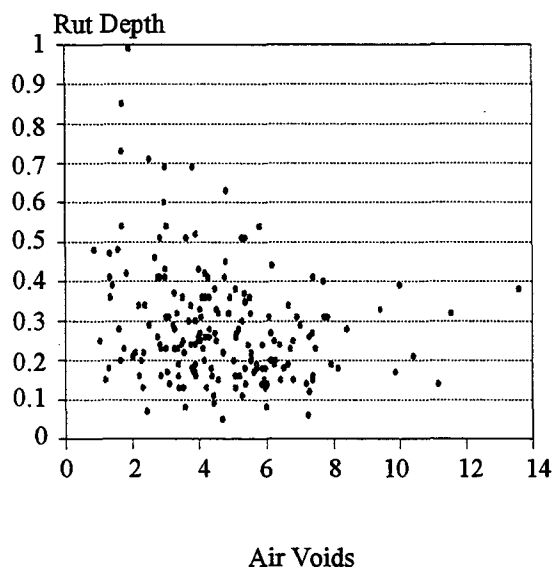
Frequency Percent Row Percent Column Percent	Freeze	No-Freeze	Total
Dry	45 18.22 46.88 40.54	51 20.65 53.13 37.50	96 38.87
Wet	66 26.72 43.71 59.46	85 34.41 56.29 62.50	151 61.13
Total	111 44.94	136 55.06	247 100.00



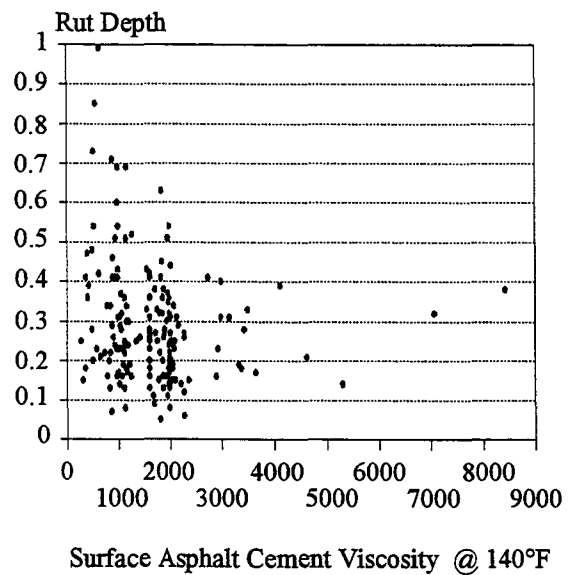
a. Rut Depth vs. HMAC Surface Thick.



b. Rut Depth vs. Asphalt Content

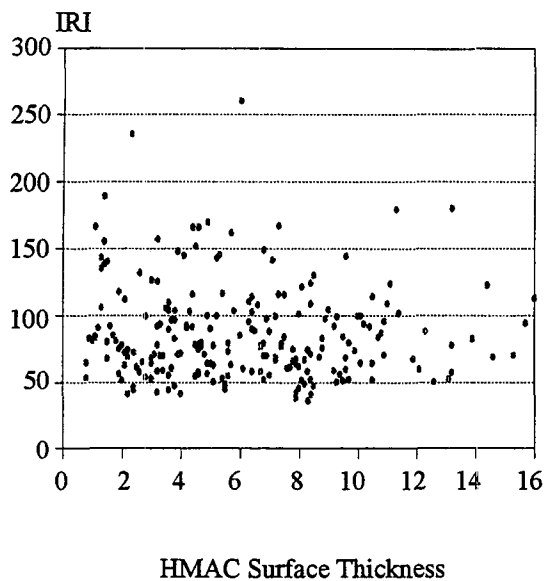


c. Rut Depth vs. Air Voids

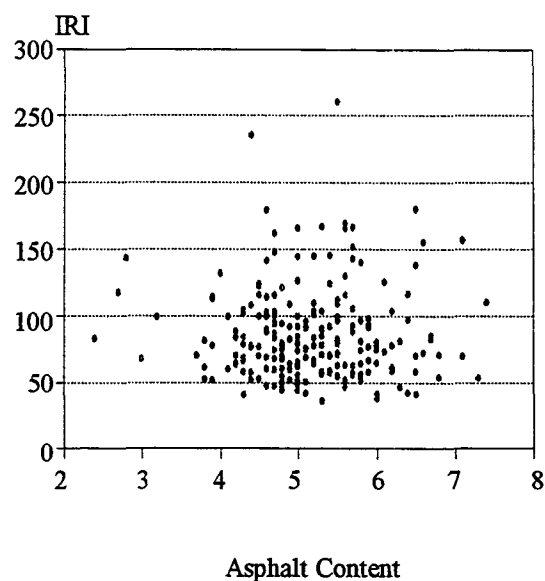


d. Rut Depth vs. Visc. @ 140°F

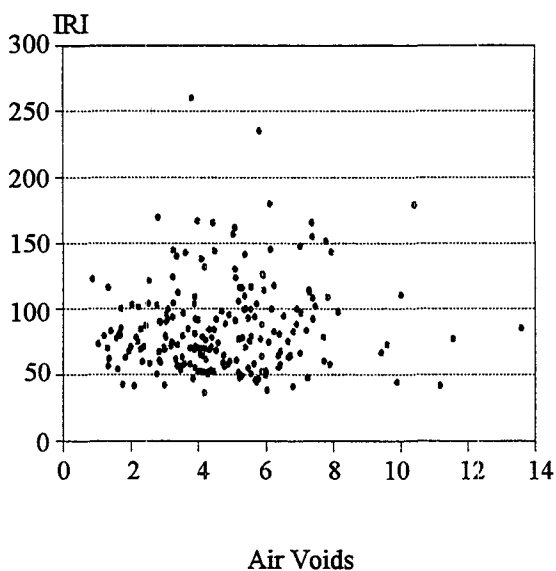
Figure 2.3. Rut Depth Scatter Plots for GPS-1 Test Sections



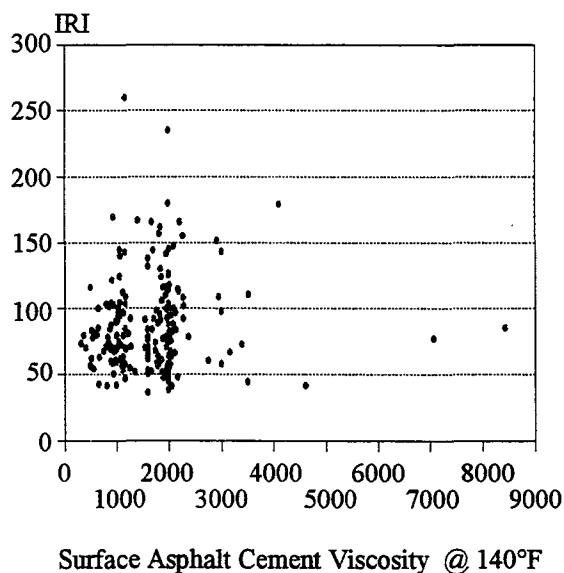
a. IRI vs. HMAC Surface Thick.



b. IRI vs. Asphalt Content

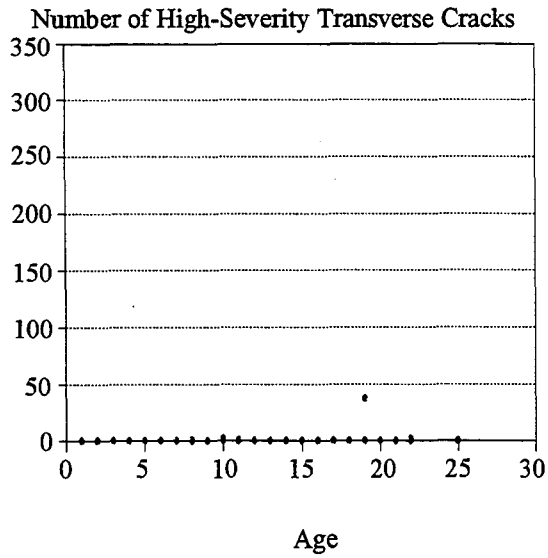


c. IRI vs. Air Voids

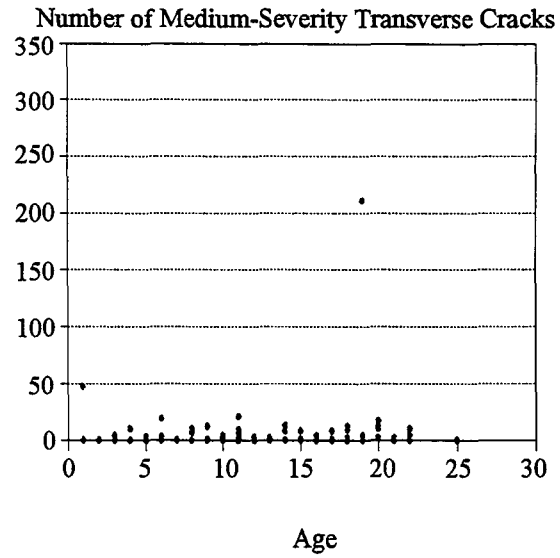


d. IRI vs. Visc. @ 140°F

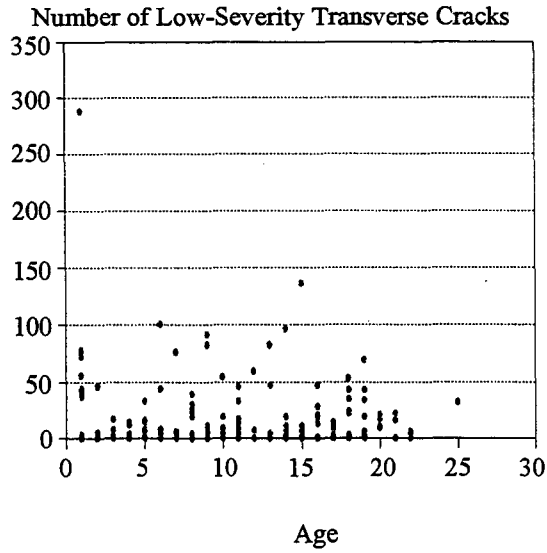
Figure 2.4. IRI Scatter Plots for GPS-1 Test Sections



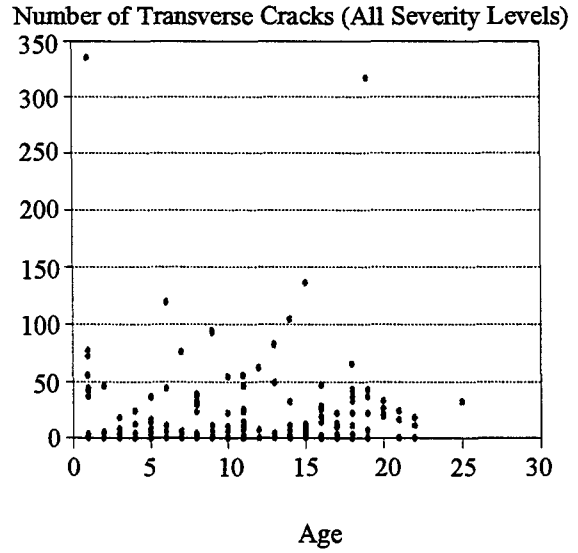
a. High-Severity



b. Medium-Severity

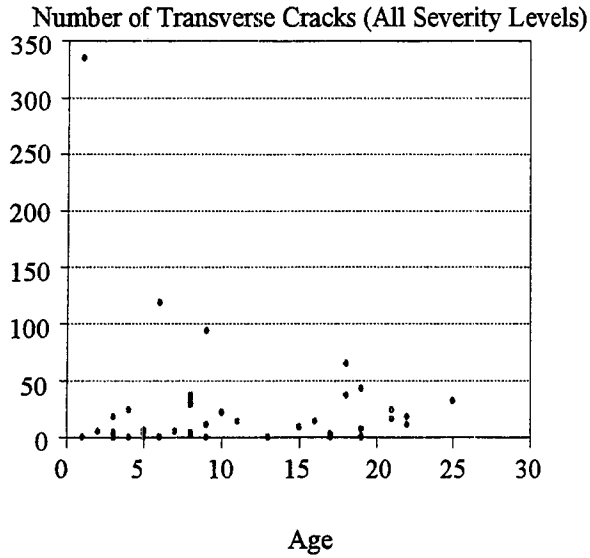


c. Low-Severity

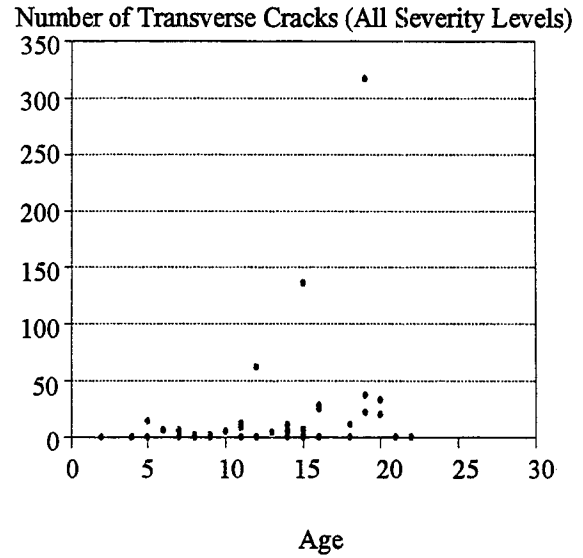


d. All Severity Levels

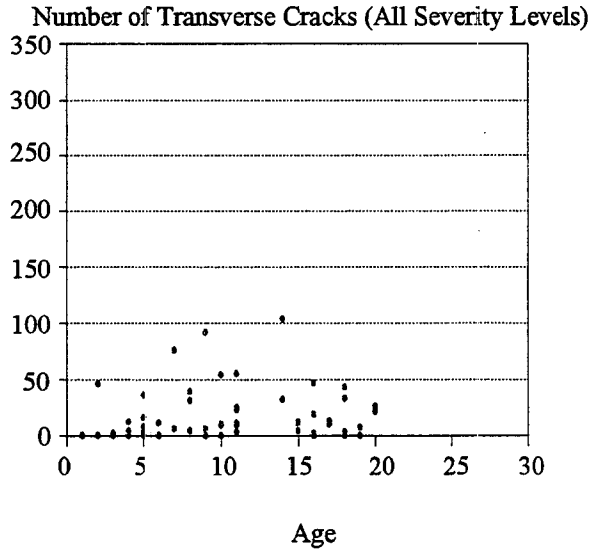
Figure 2.5. Number of Transverse Cracks vs. Age for GPS-1 Test Sections



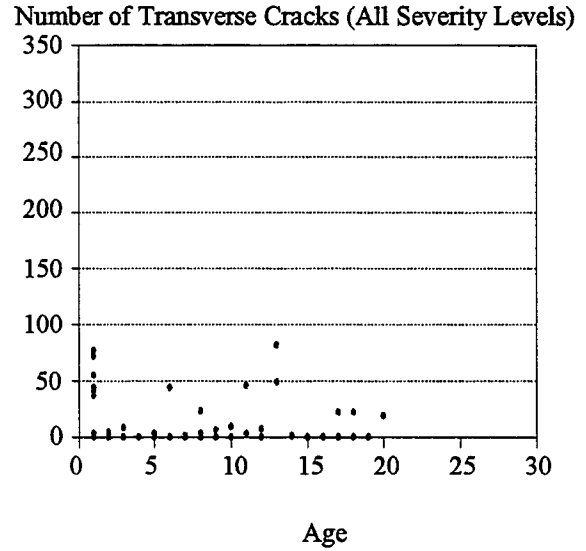
a. Dry-Freeze



b. Dry-No Freeze

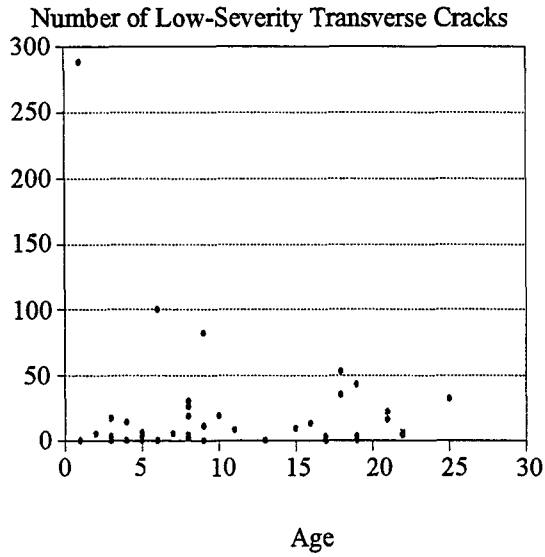


c. Wet-Freeze

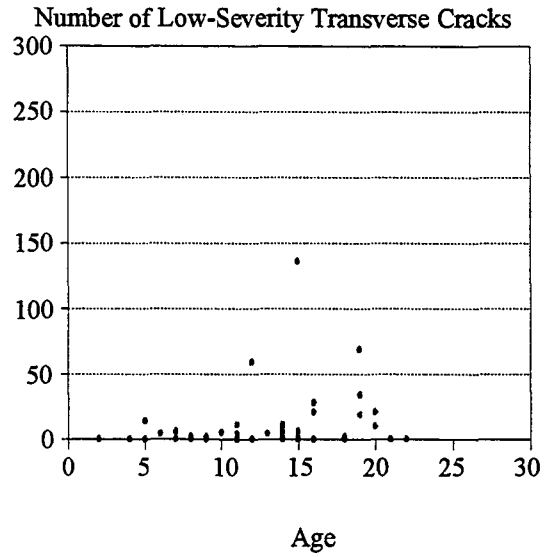


d. Wet-No Freeze

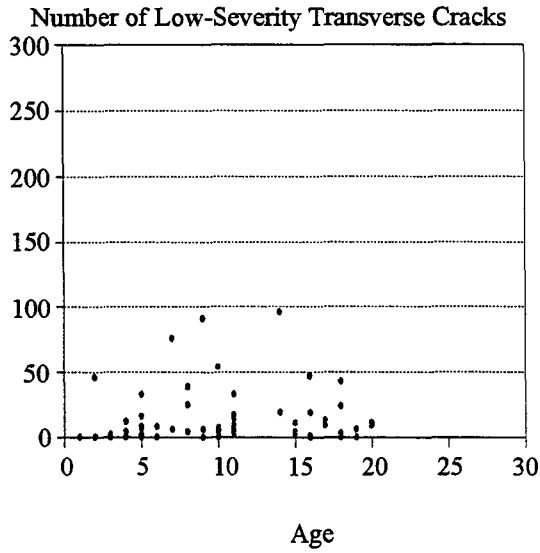
Figure 2.6. Number of Transverse Cracks (All Severity Levels) vs. Age for GPS-1 Test Sections



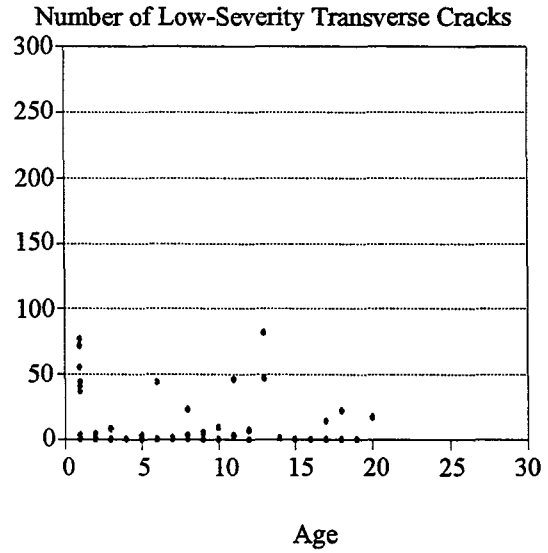
a. Dry-Freeze



b. Dry-No Freeze

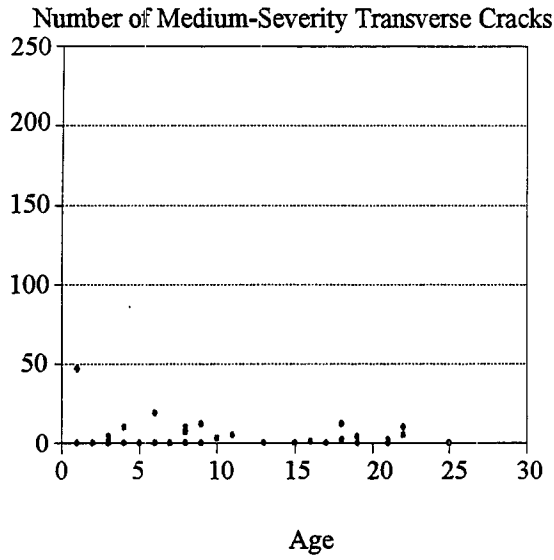


c. Wet-Freeze

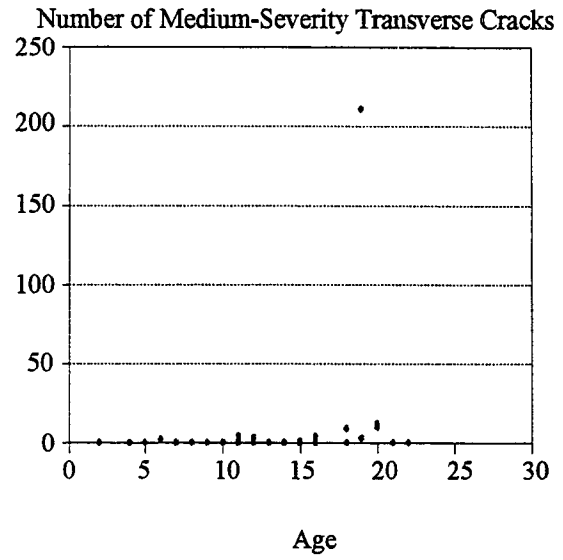


d. Wet-No Freeze

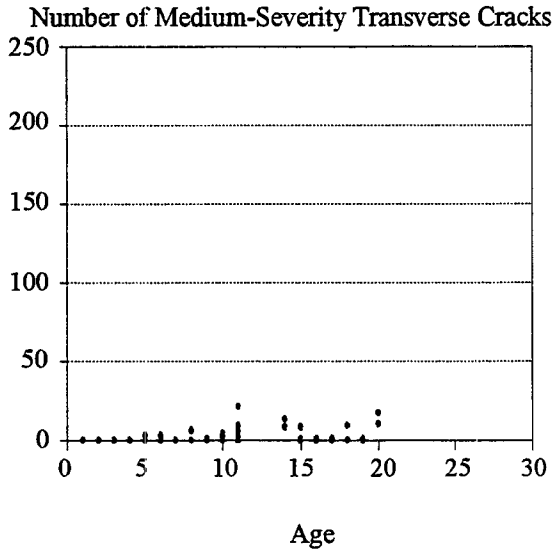
Figure 2.7. Number of Low-Severity Transverse Cracks vs. Age for GPS-1 Test Sections



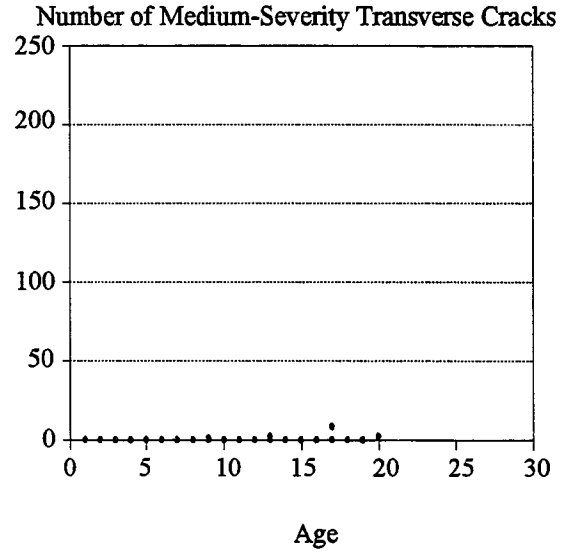
a. Dry-Freeze



b. Dry-No Freeze

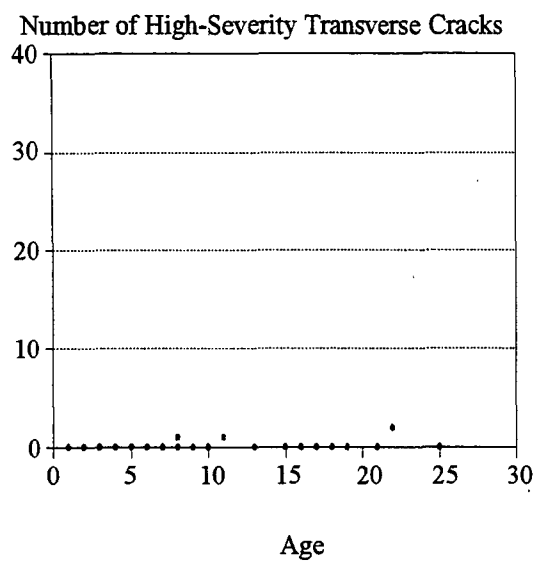


c. Wet-Freeze

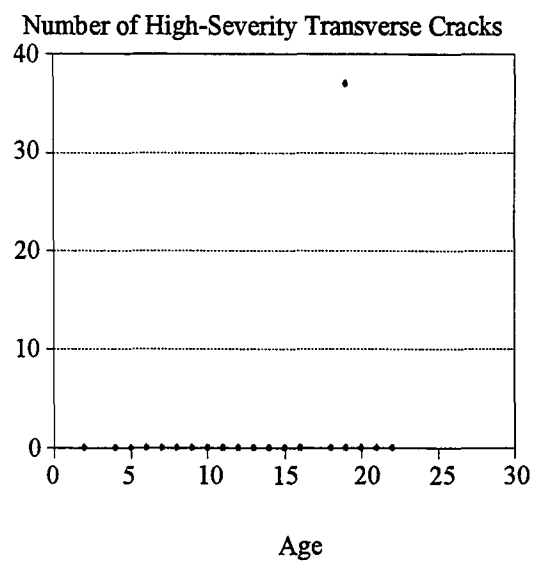


d. Wet-No Freeze

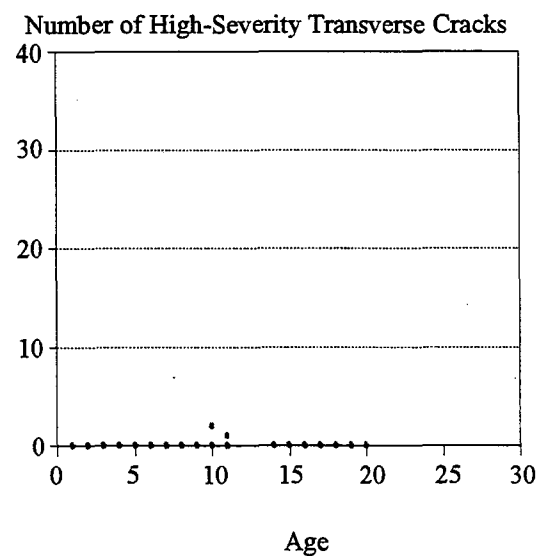
Figure 2.8. Number of Medium-Severity Transverse Cracks vs. Age for GPS-1 Test Sections



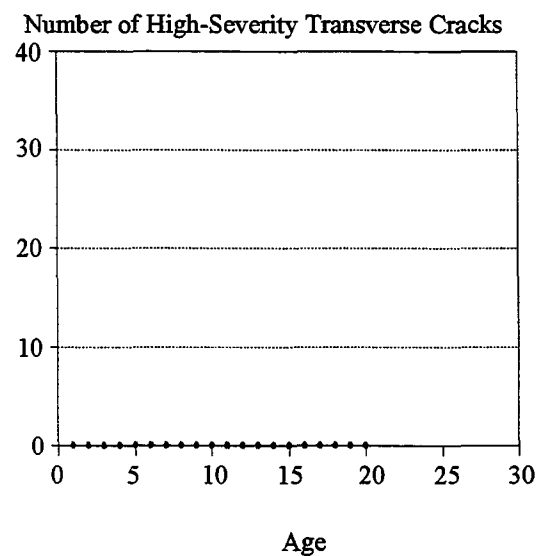
a. Dry-Freeze



b. Dry-No Freeze

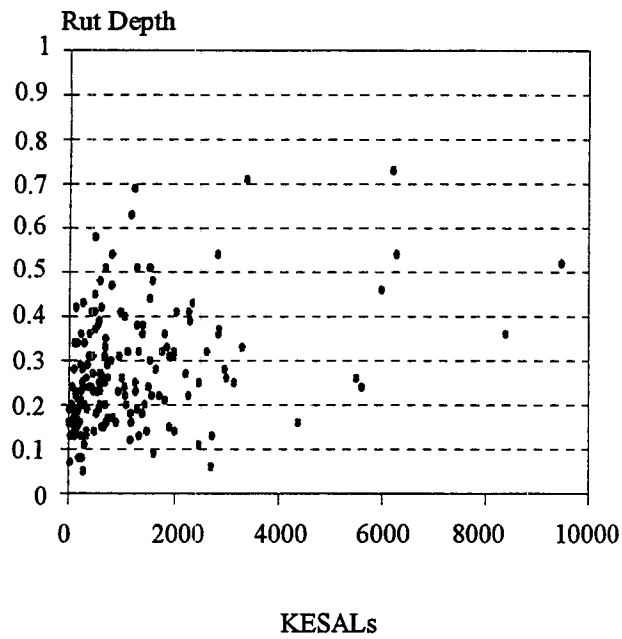


c. Wet-Freeze

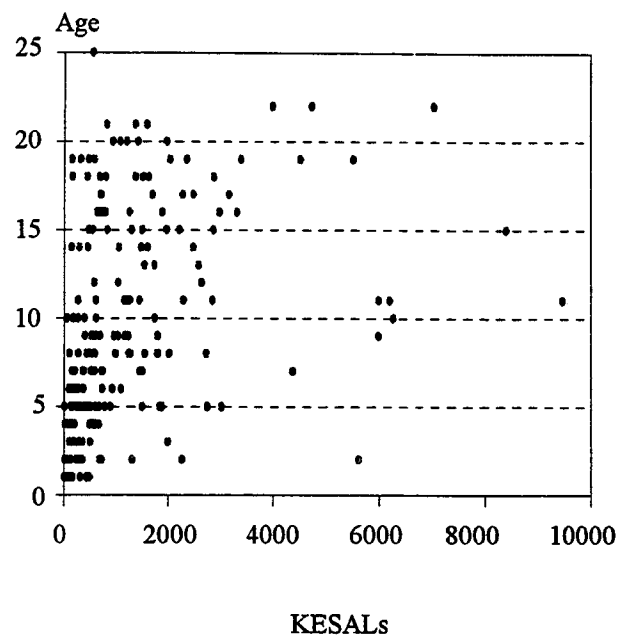


d. Wet-No Freeze

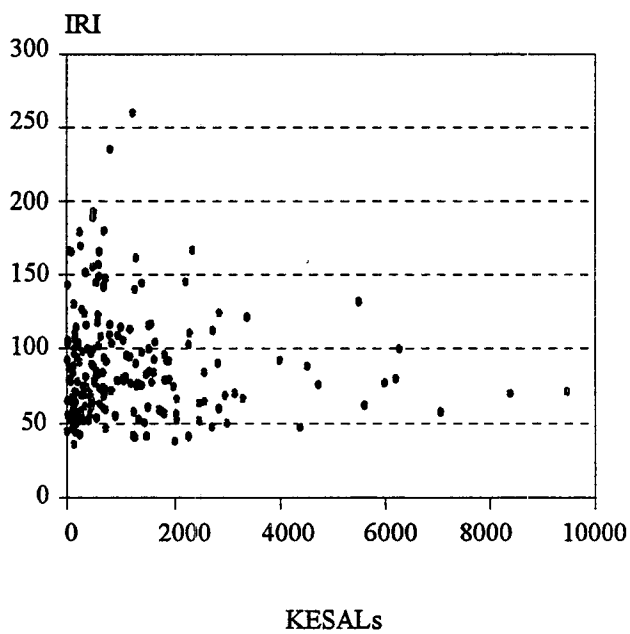
Figure 2.9. Number of High-Severity Transverse Cracks vs. Age for GPS-1 Test Sections



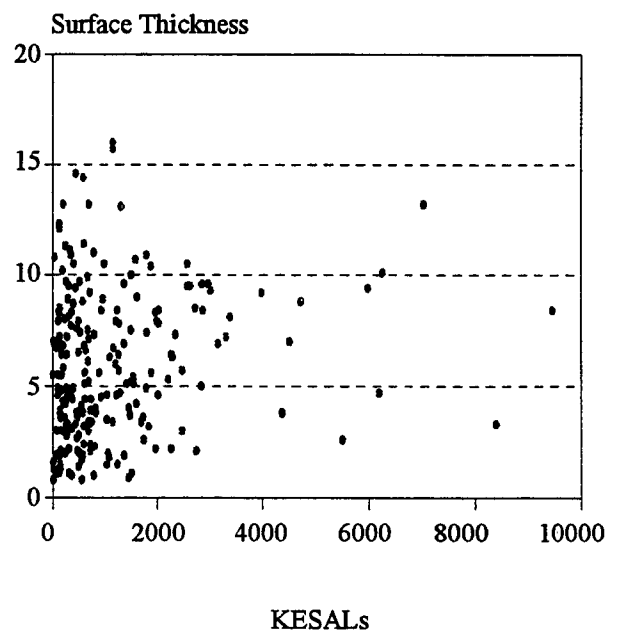
a. Rut Depth vs. KESALs



b. Age vs. KESALs

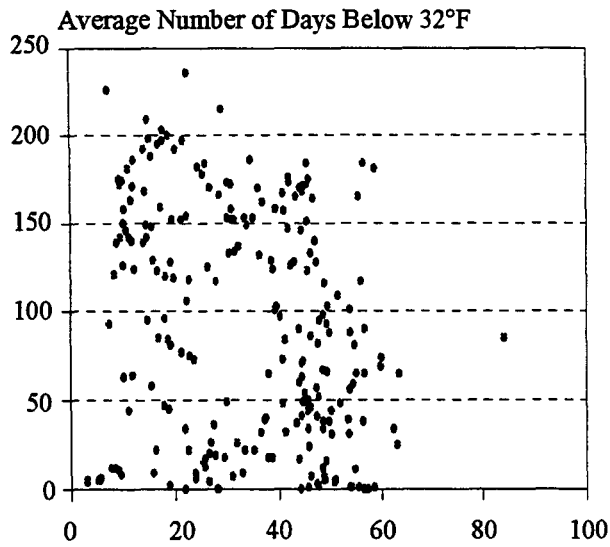


c. IRI vs. KESALs



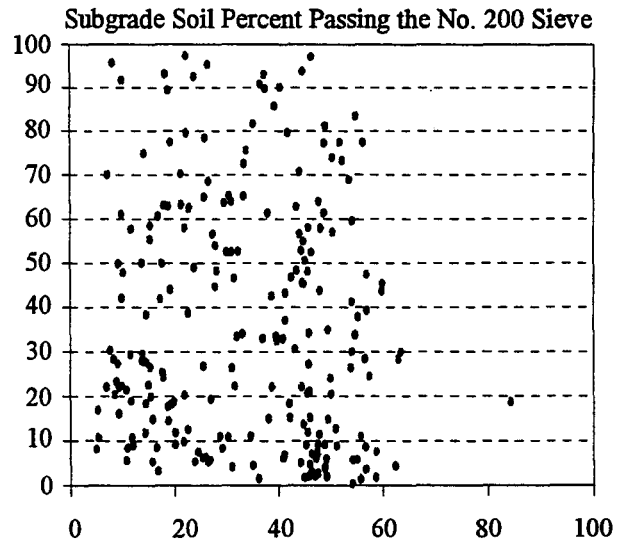
d. Surface Thick. vs. KESALs

Figure 2.10. Cumulative KESALs Scatter Plots for GPS-1 Test Sections



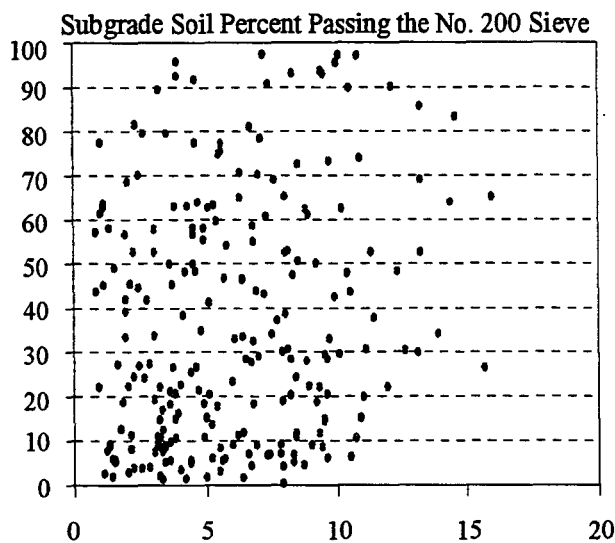
Average Annual Total Precipitation

a. Days <32°F vs. Ann. Prec.



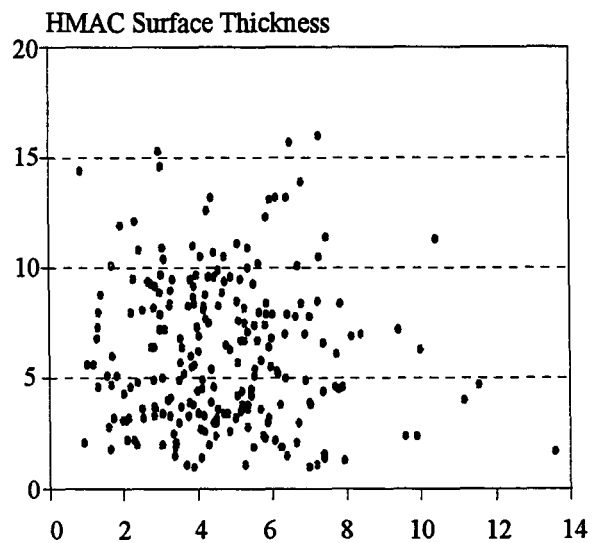
Average Annual Total Precipitation

b. Subgrade <#200 vs. Ann. Prec.



HMAC Surface Thickness

c. Subgrade <#200 vs. HMAC Thick.



HMAC Air Voids

d. HMAC Thick. vs. HMAC Air Voids

Figure 2.11. Scatter Plots for GPS-1 Test Sections

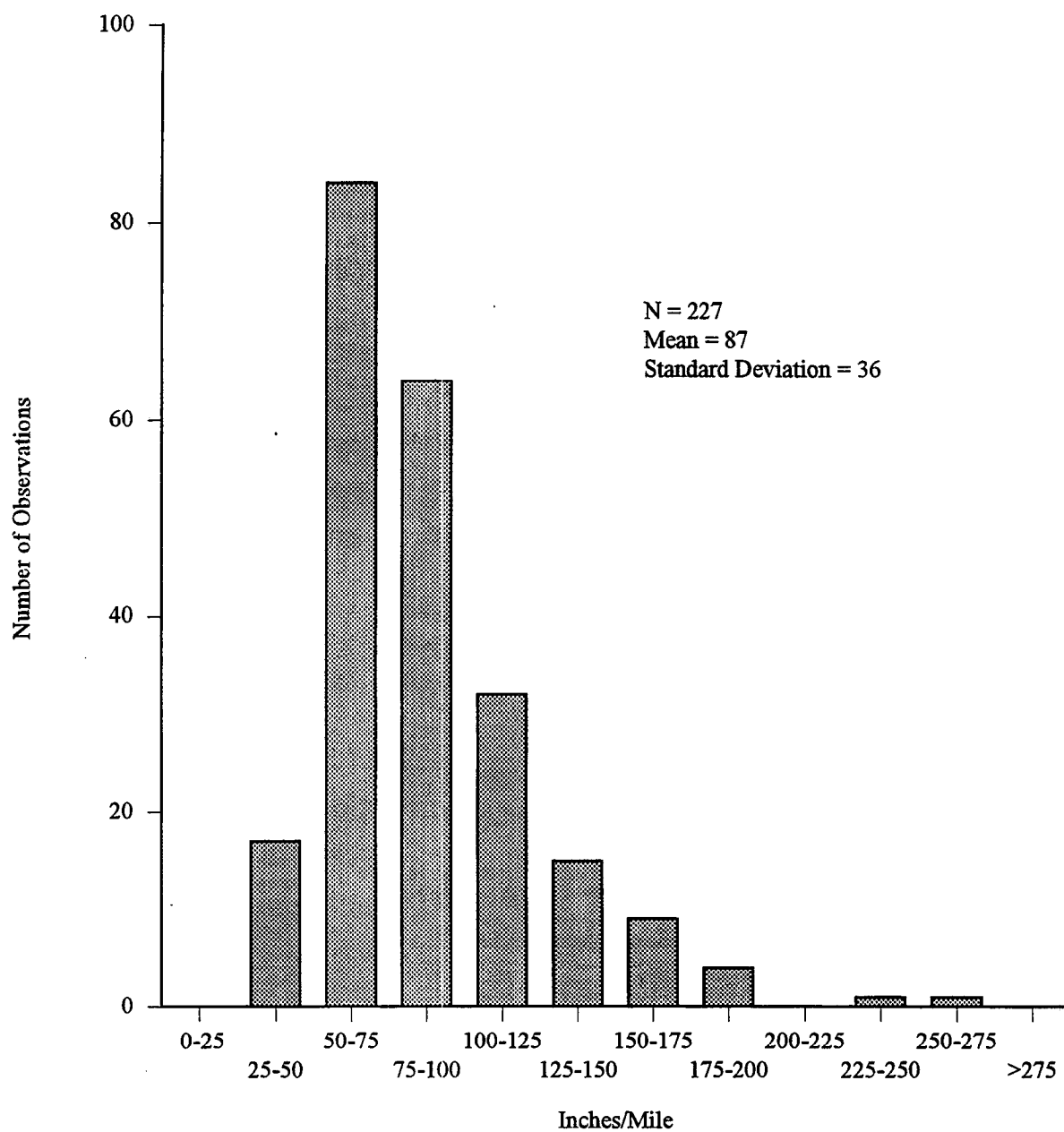


Figure 2.12. Distribution of Measured International Roughness Index (IRI) for GPS-1 Test Sections

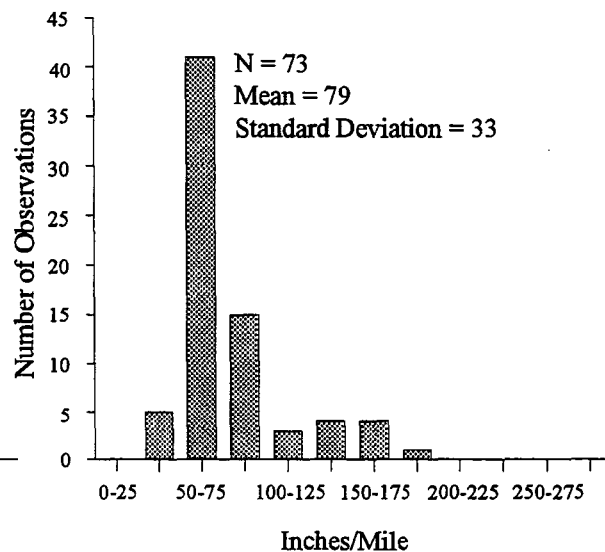
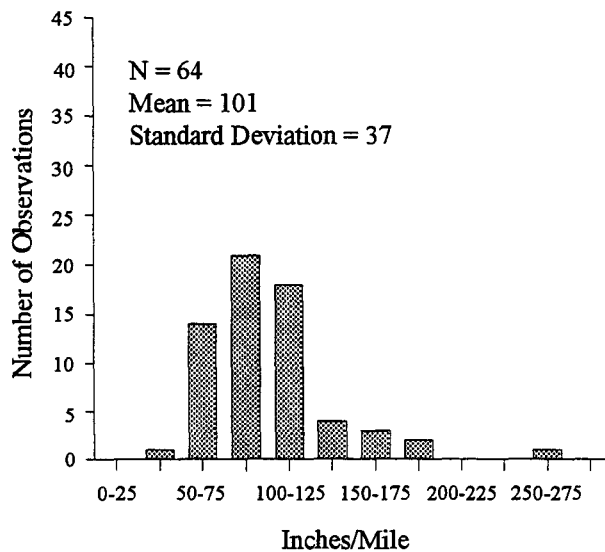
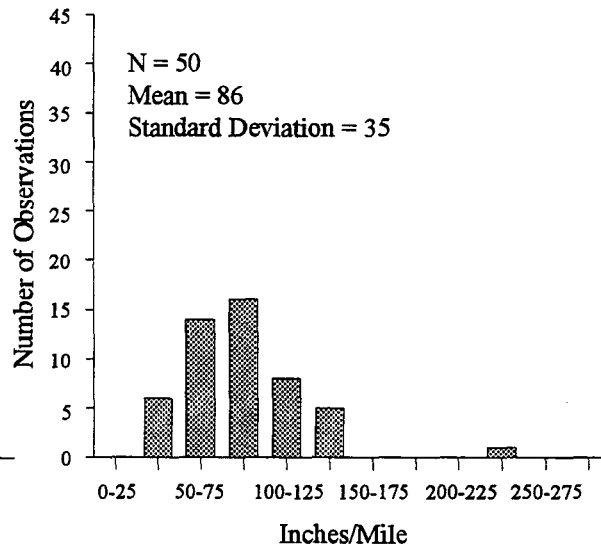
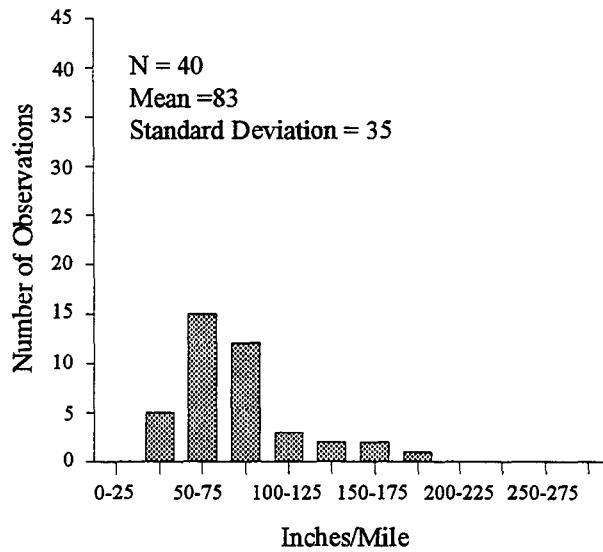


Figure 2.13. Distributions of Measured International Roughness Index (IRI) by Environmental Regions for GPS-1 Test Sections

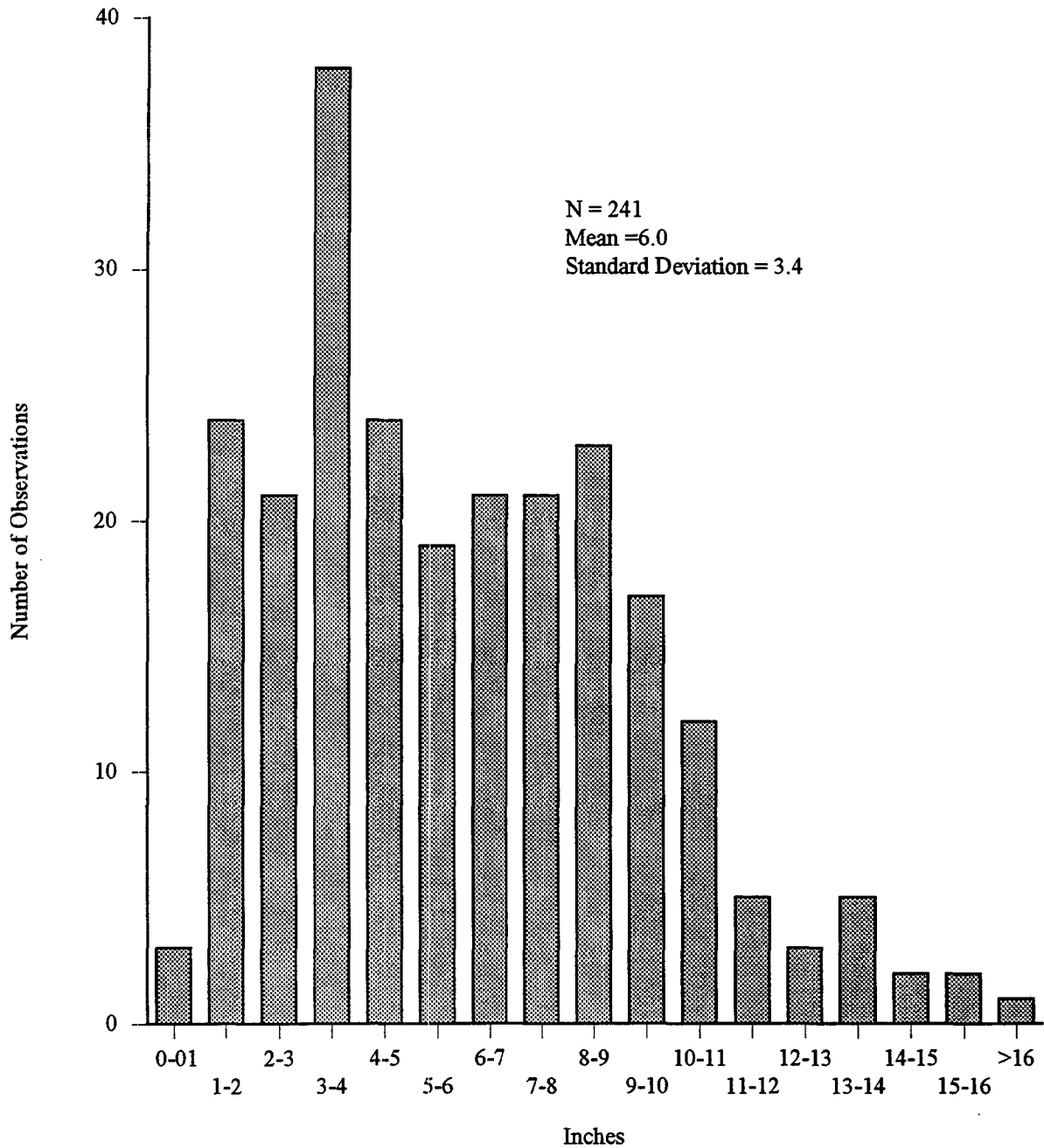
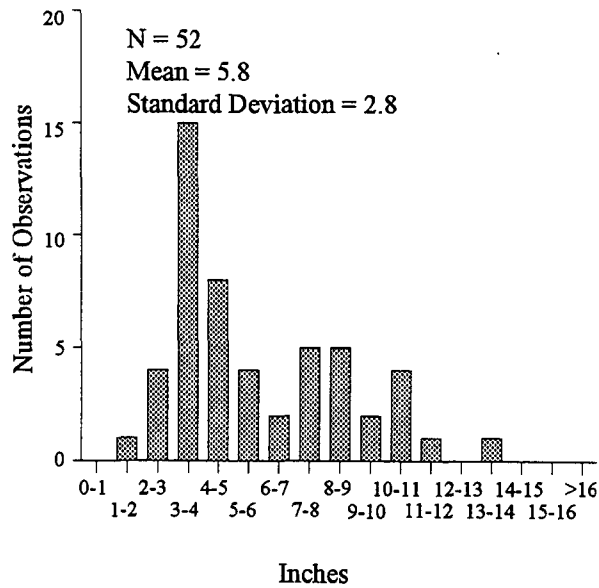
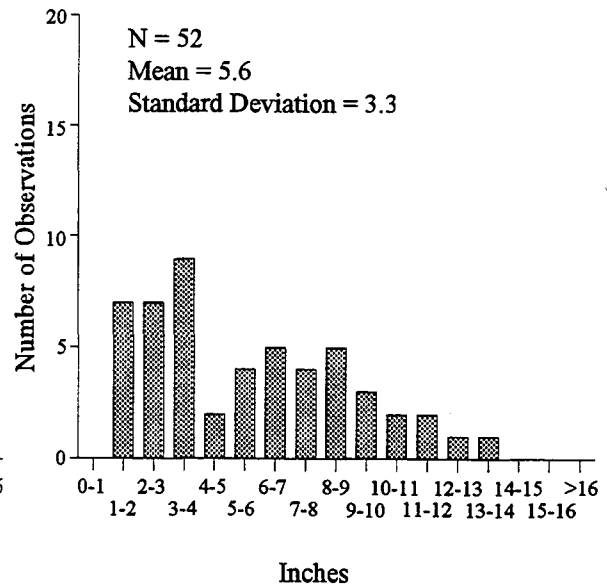


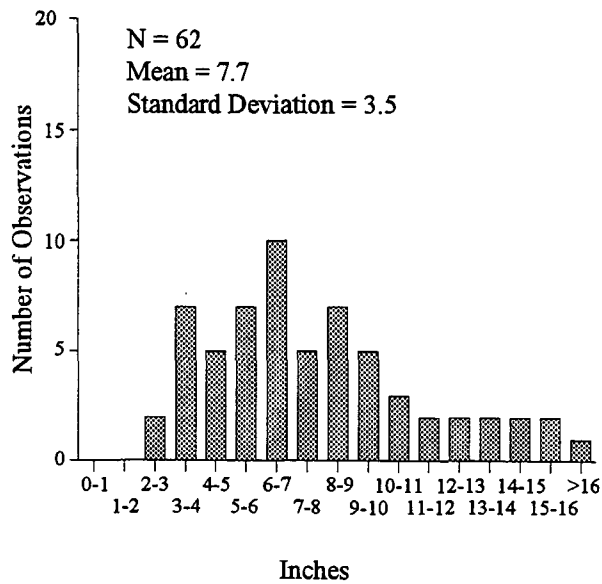
Figure 2.14. Distribution of HMAC Thickness for GPS-1 Test Sections



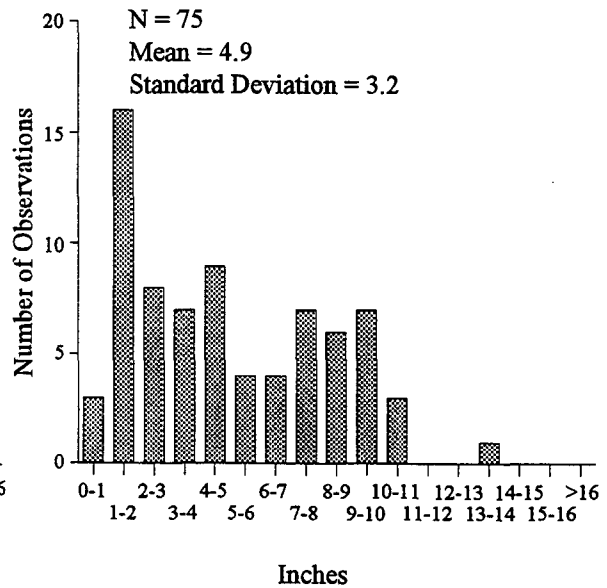
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.15. Distributions of HMAC Thickness by Environmental Regions for GPS-1 Test Sections

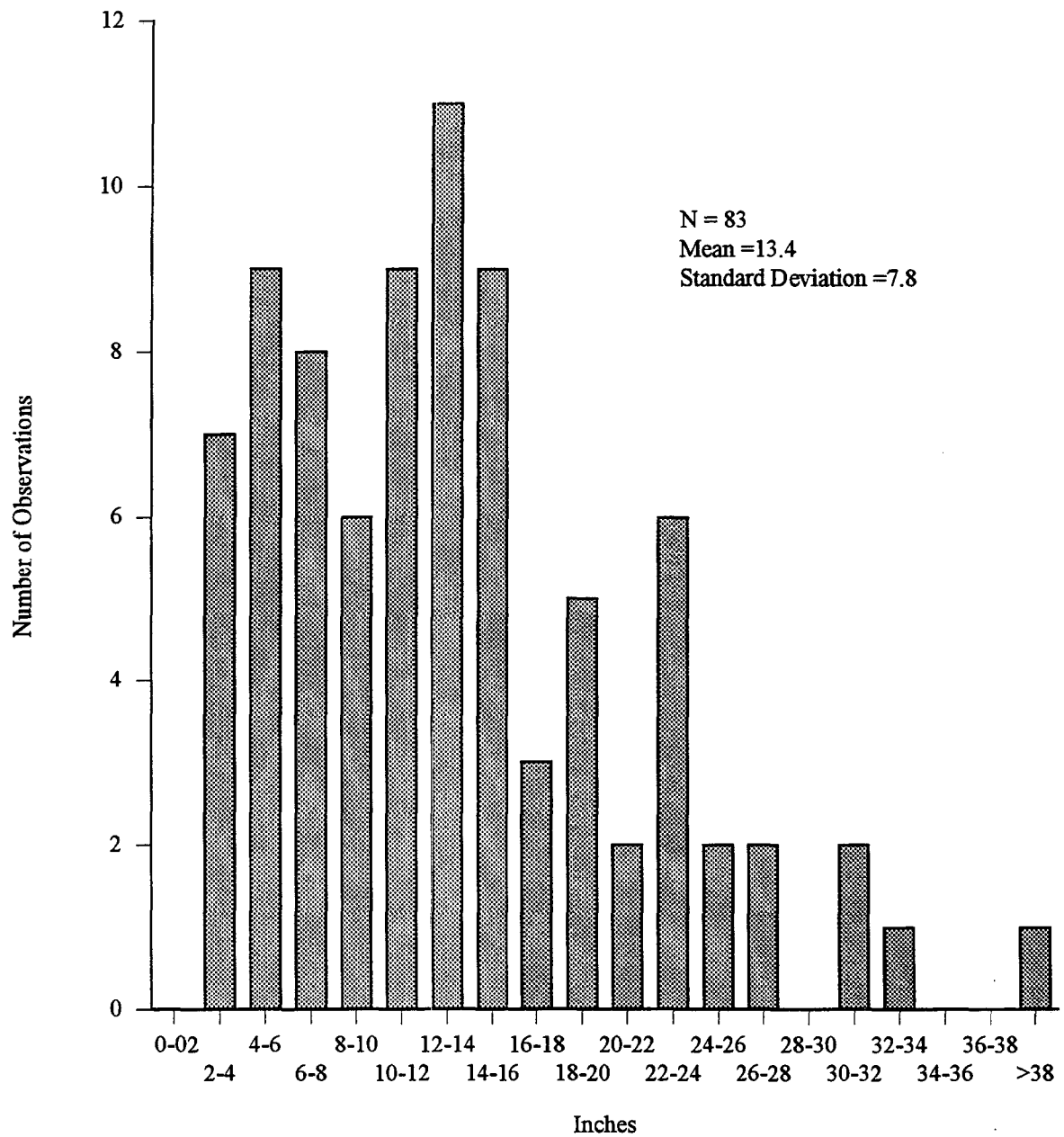
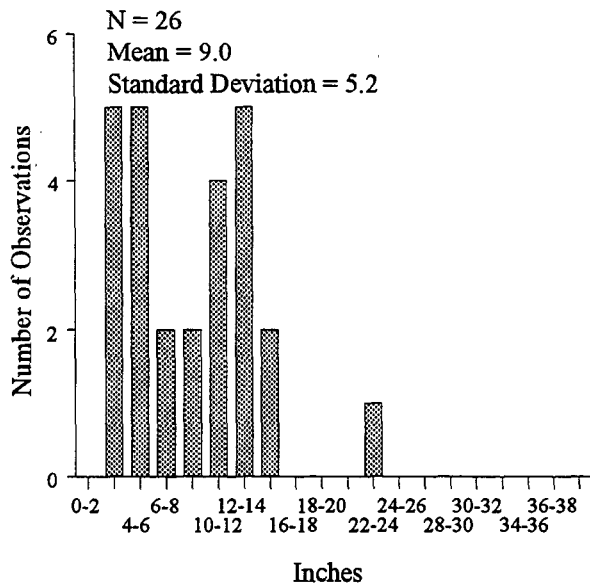
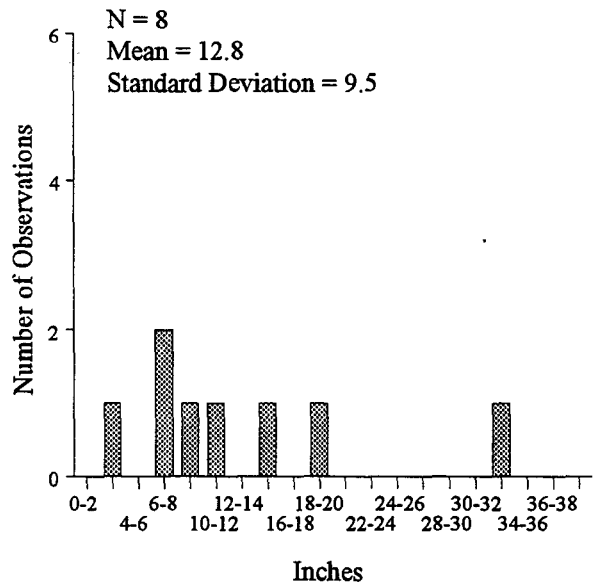


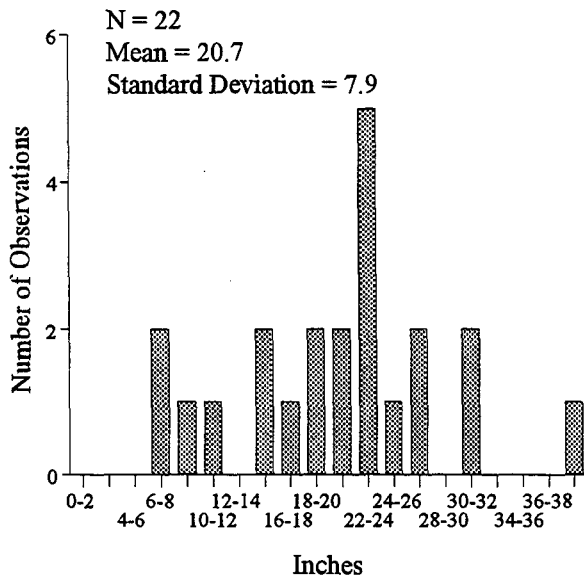
Figure 2.16. Distribution of Granular Subbase Thickness for GPS-1 Test Sections



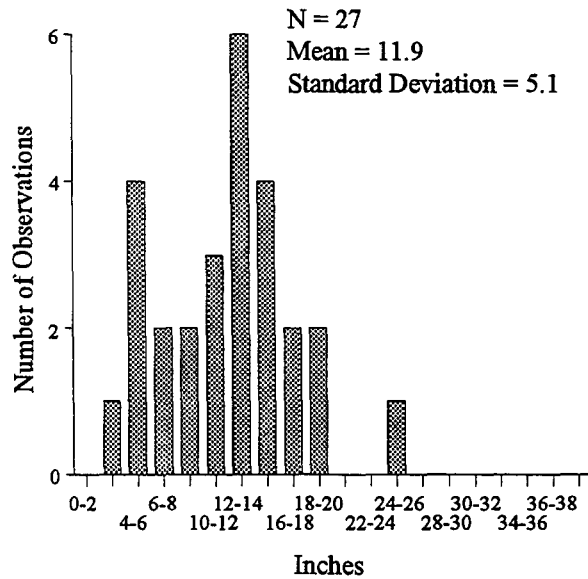
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.17. Distributions of Granular Subbase Thickness by Environmental Regions for GPS-1 Test Sections

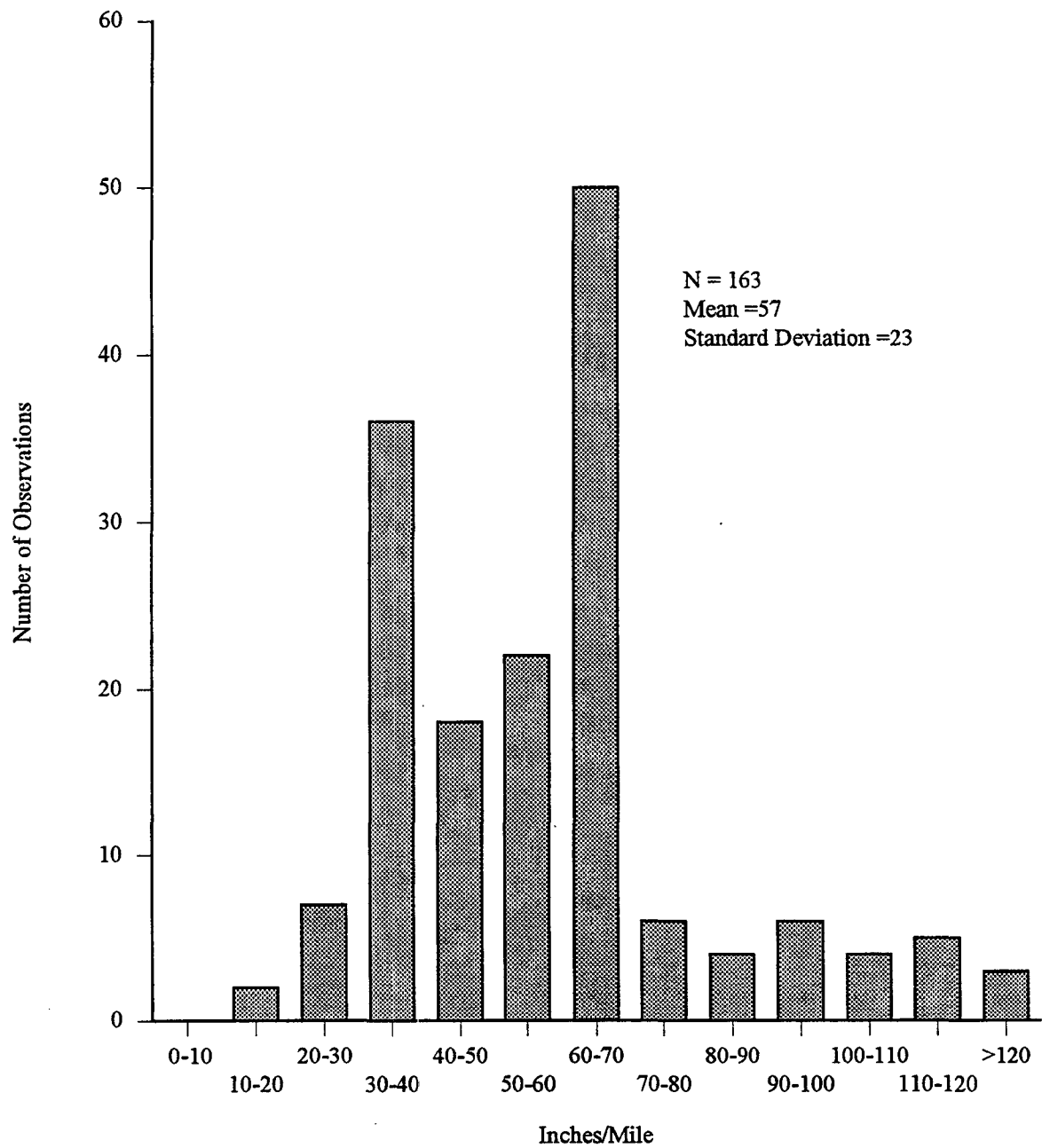
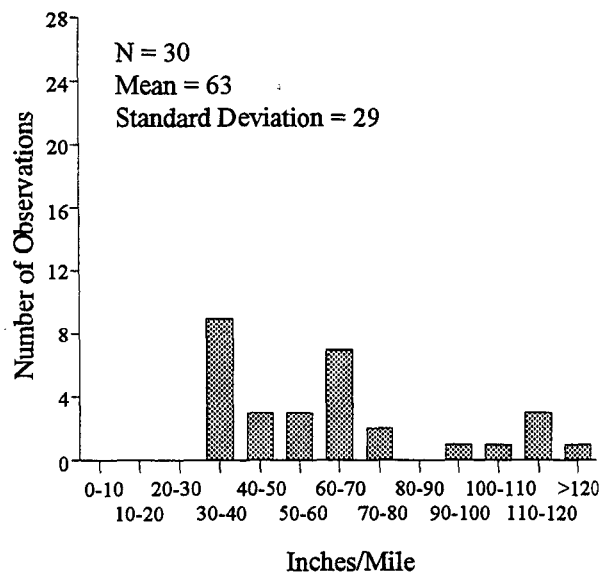
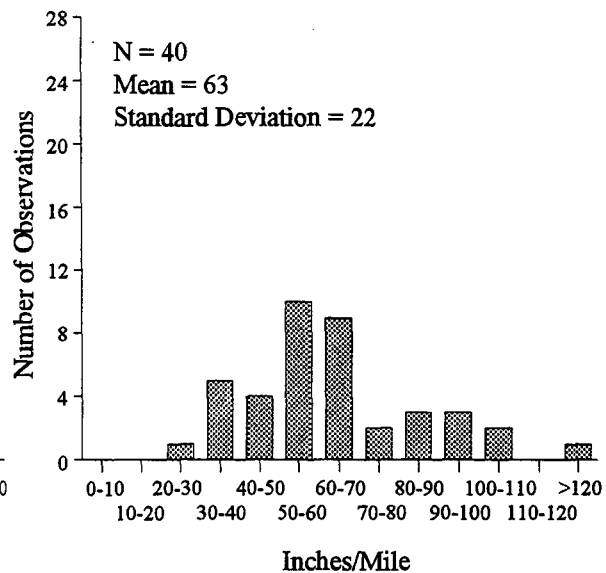


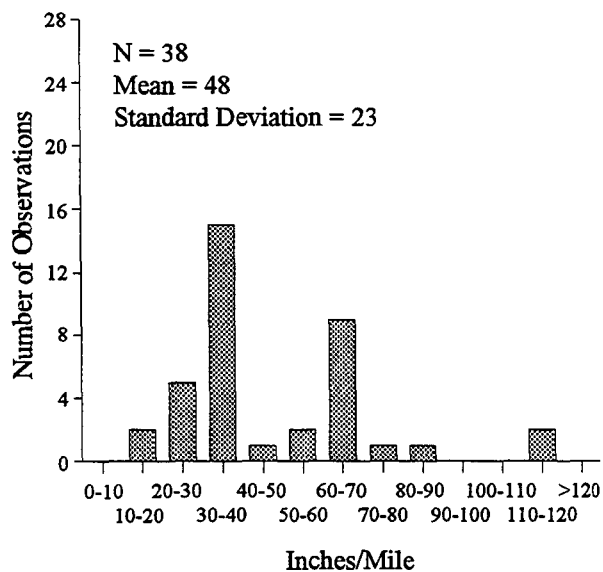
Figure 2.18. Distribution of Initial International Roughness Index (IRI) for GPS-1 Test Sections



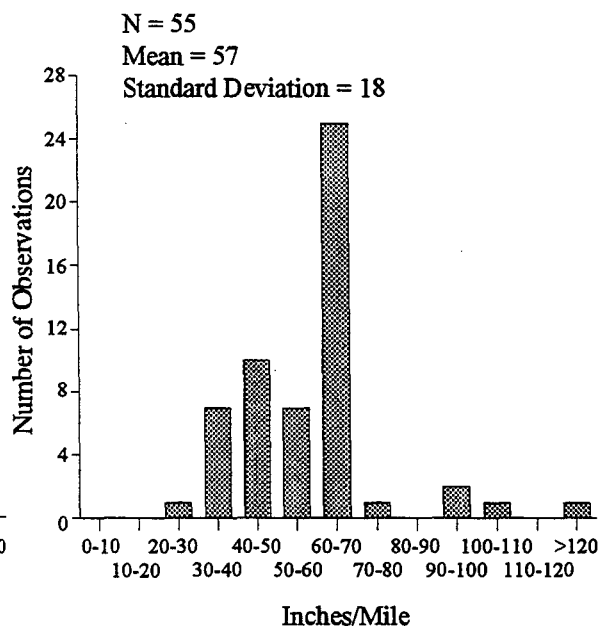
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.19. Distributions of Initial International Roughness Index (IRI) by Environmental Regions for GPS-1 Test Sections

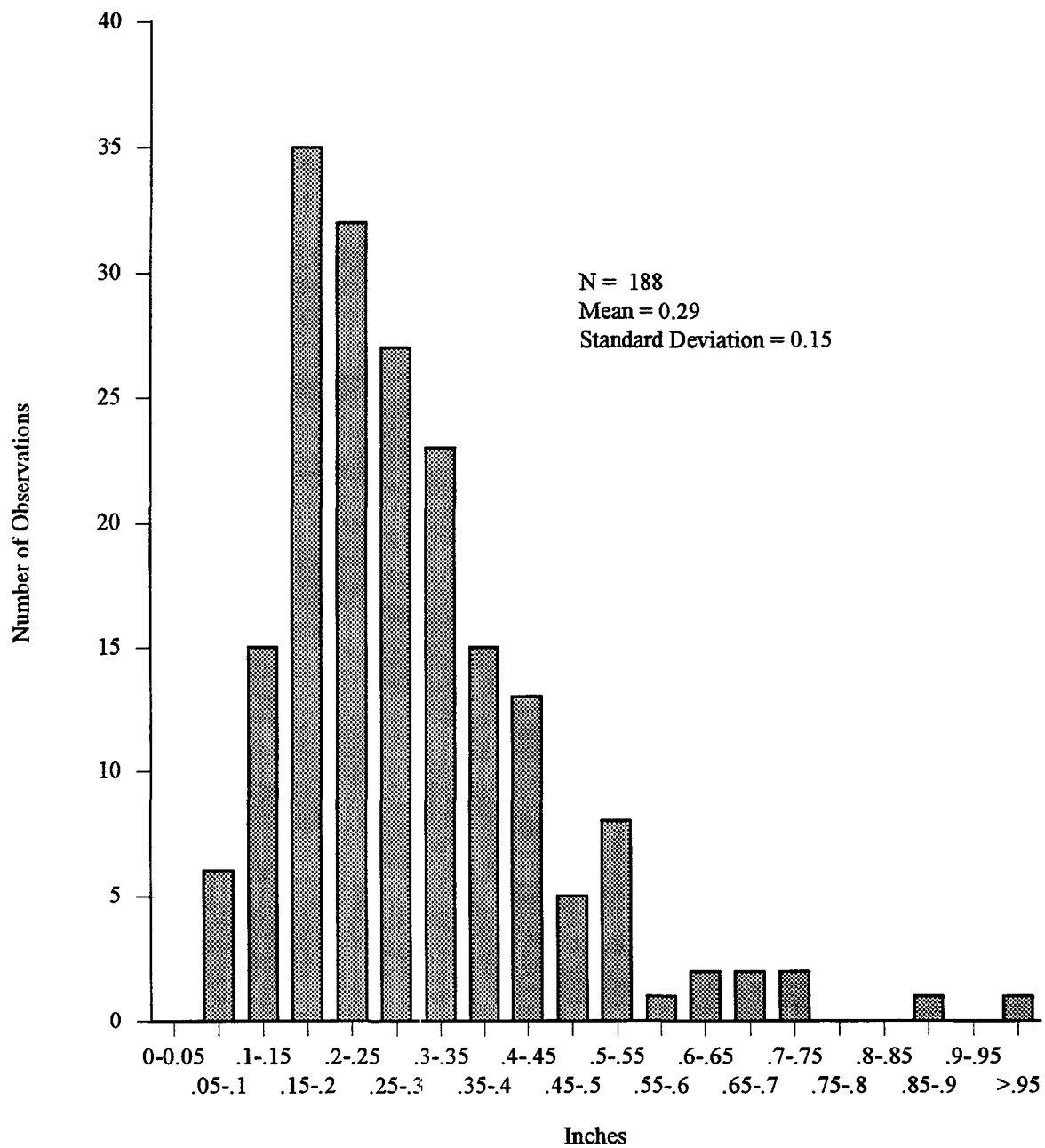
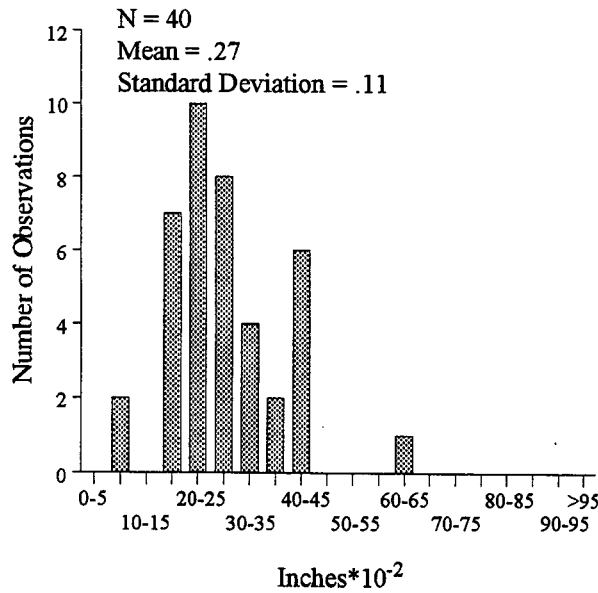
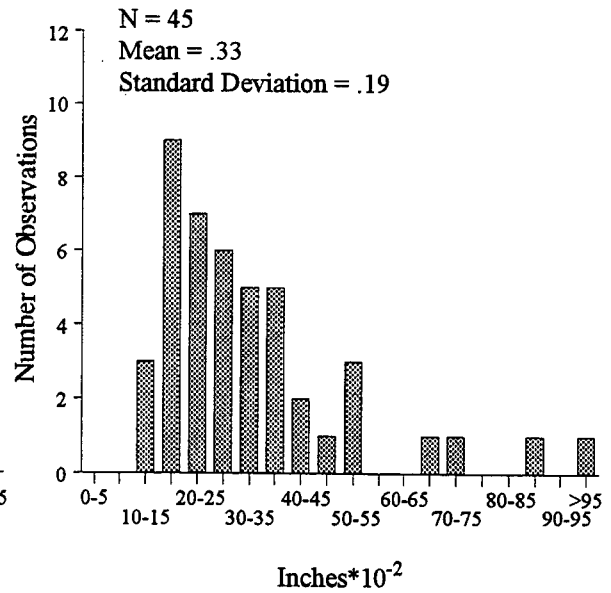


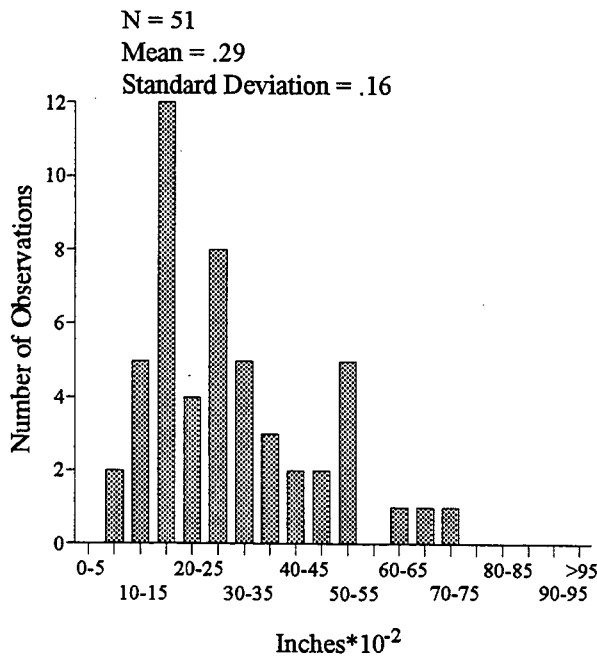
Figure 2.20. Distribution of Rut Depth for GPS-1 Test Sections



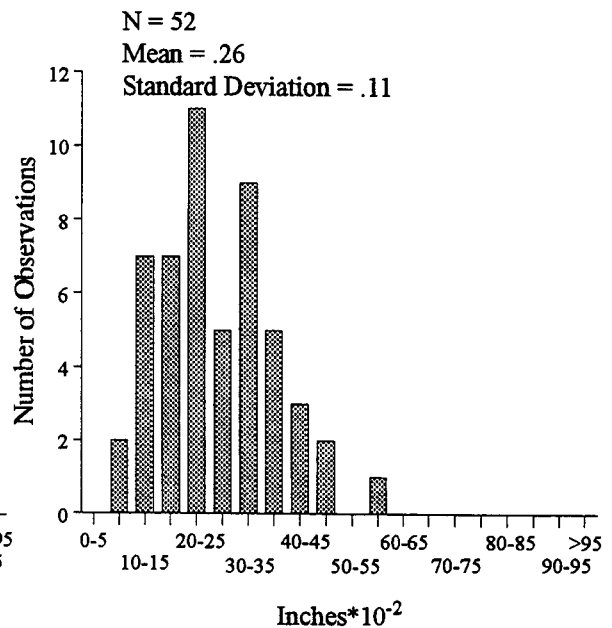
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.21. Distributions of Rut Depth by Environmental Regions for GPS-1 Test Sections

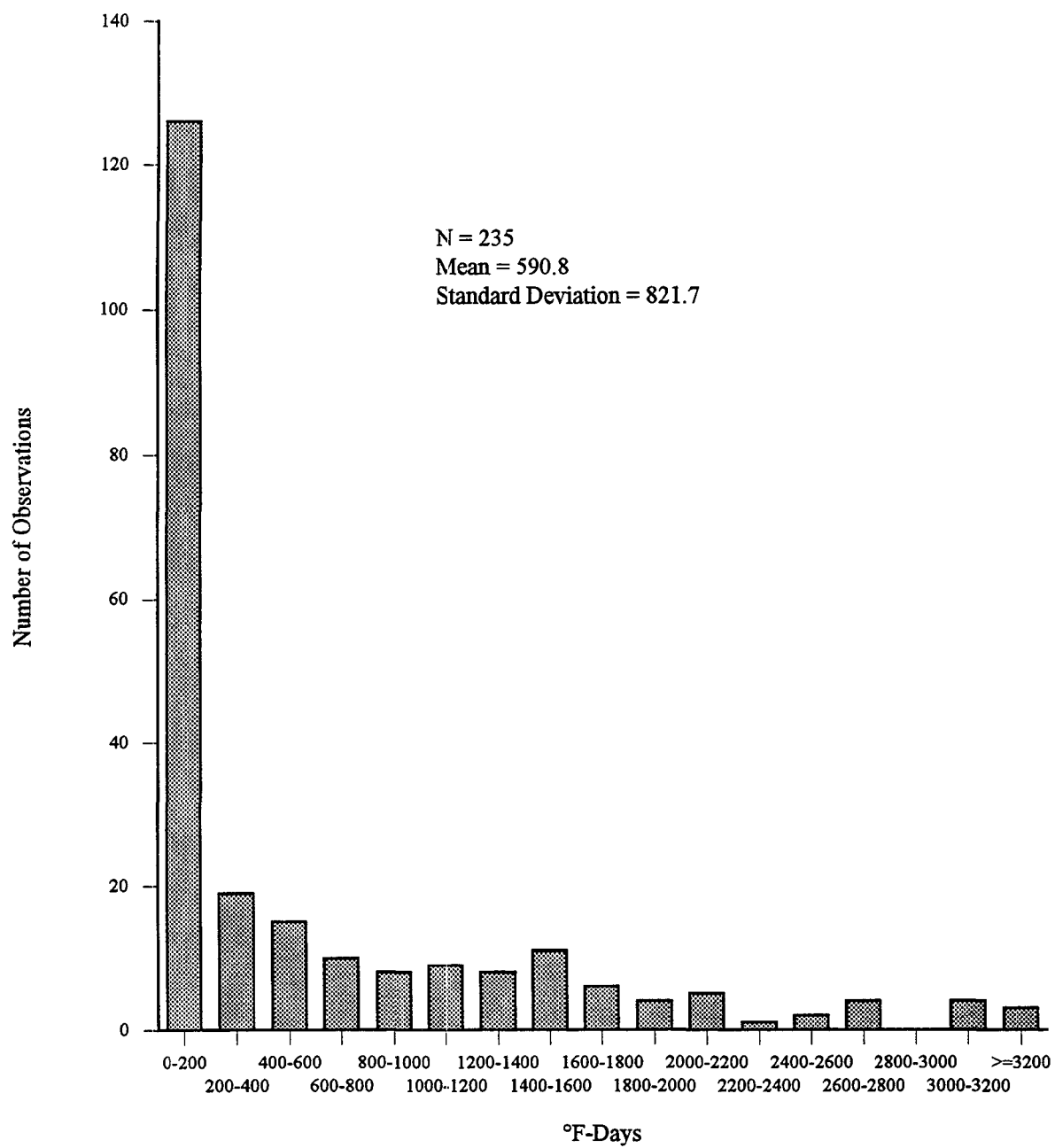
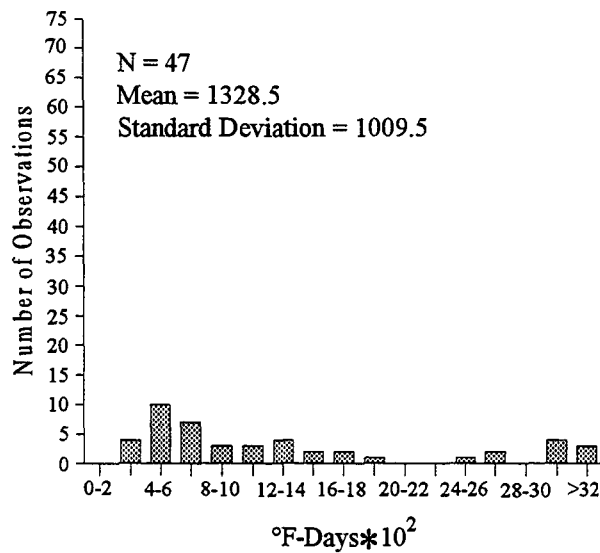
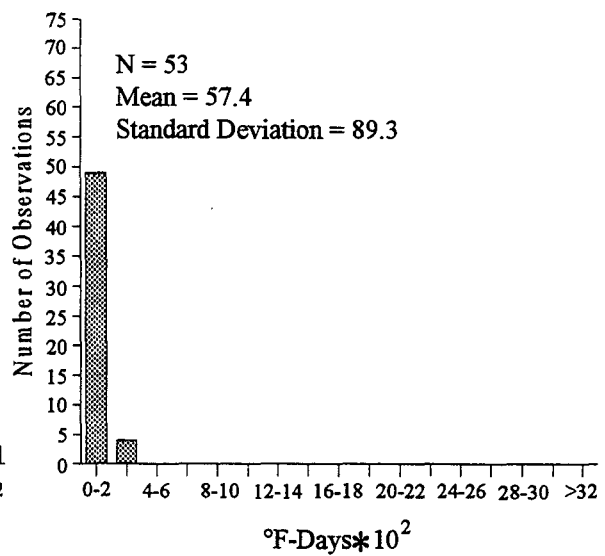


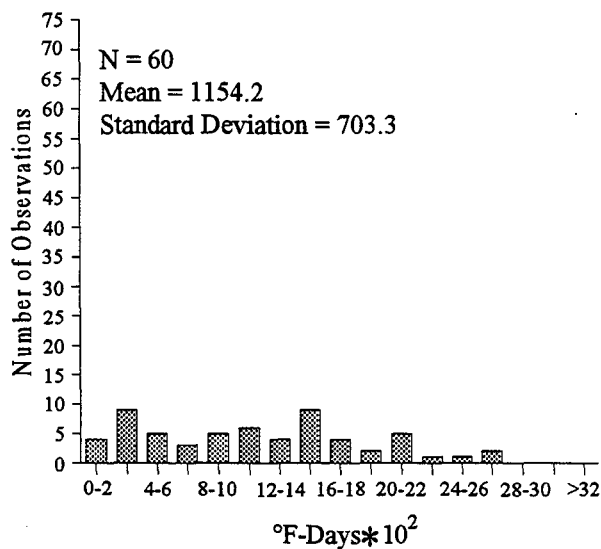
Figure 2.22. Distribution of the Freeze Index for GPS-1 Test Sections



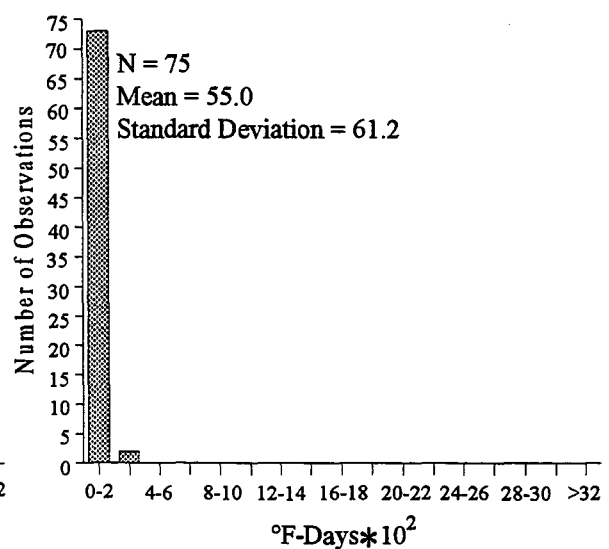
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.23. Distributions of the Freeze Index by Environmental Regions for GPS-1 Test Sections

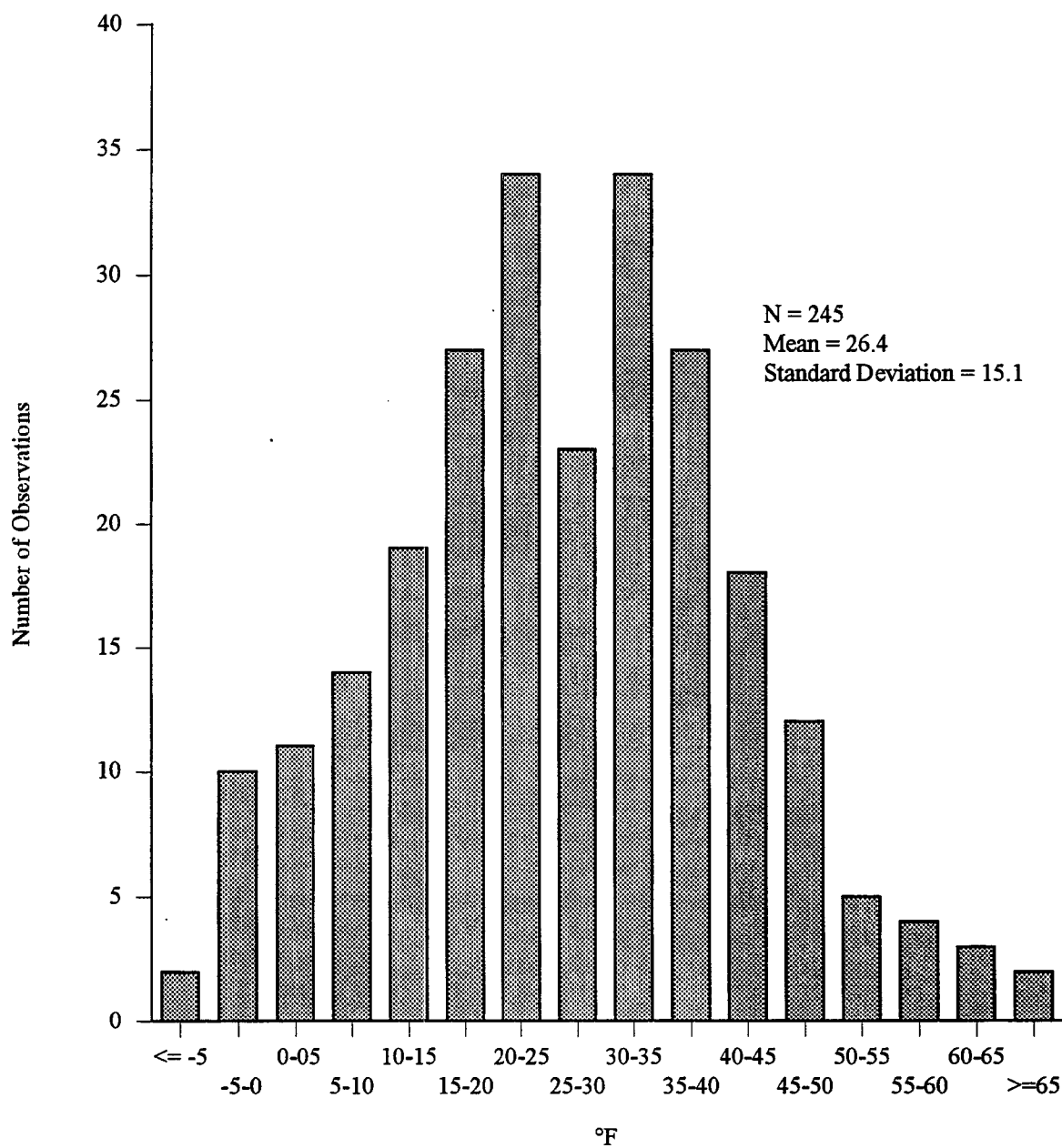
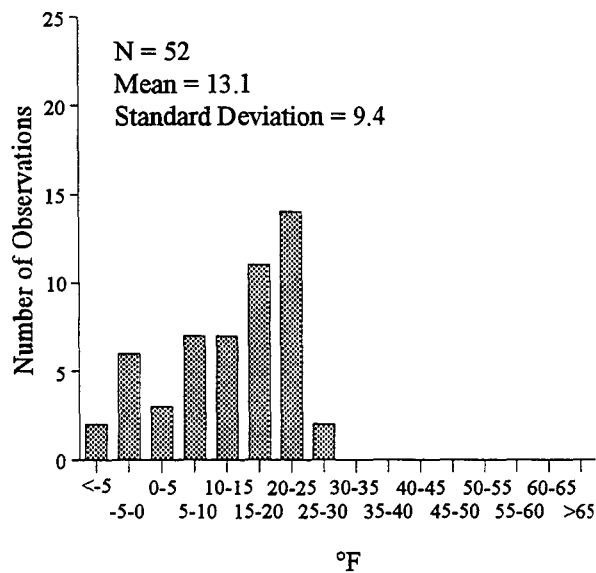
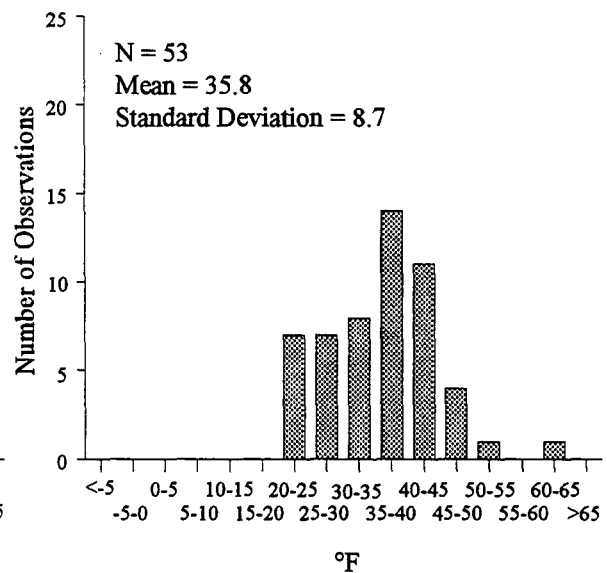


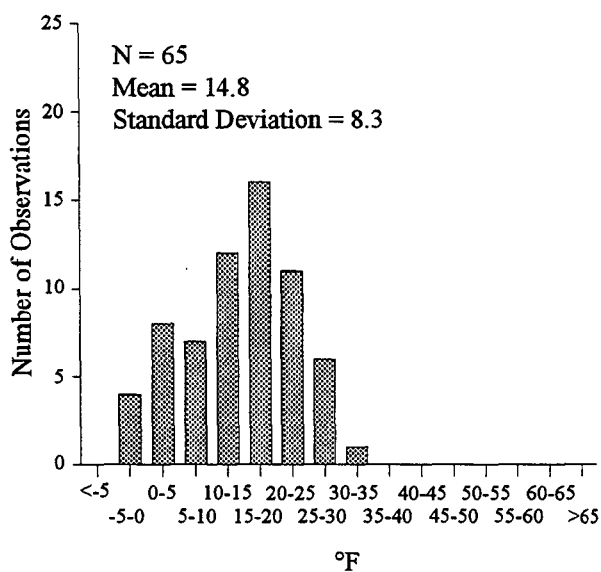
Figure 2.24. Distribution of the Average Annual Minimum Temperature (for the Months of December, January, and February) for GPS-1 Test Sections



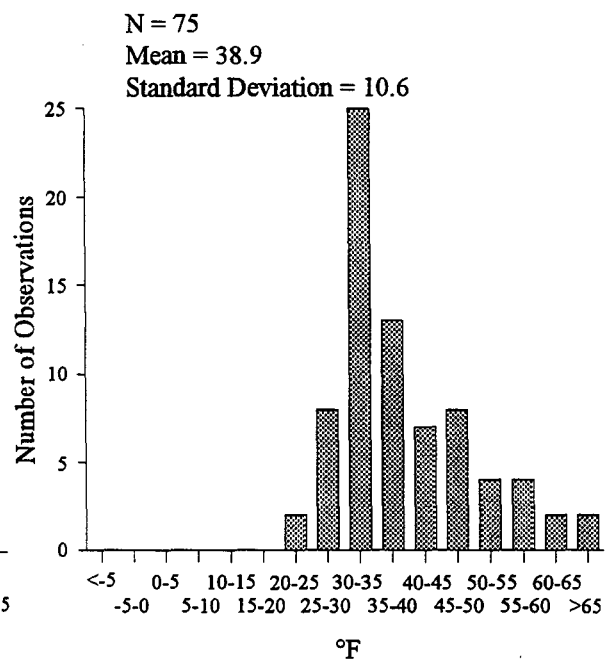
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.25. Distributions of the Average Annual Minimum Temperature (for the Months of December, January and February) by Environmental Regions for GPS-1 Test Sections

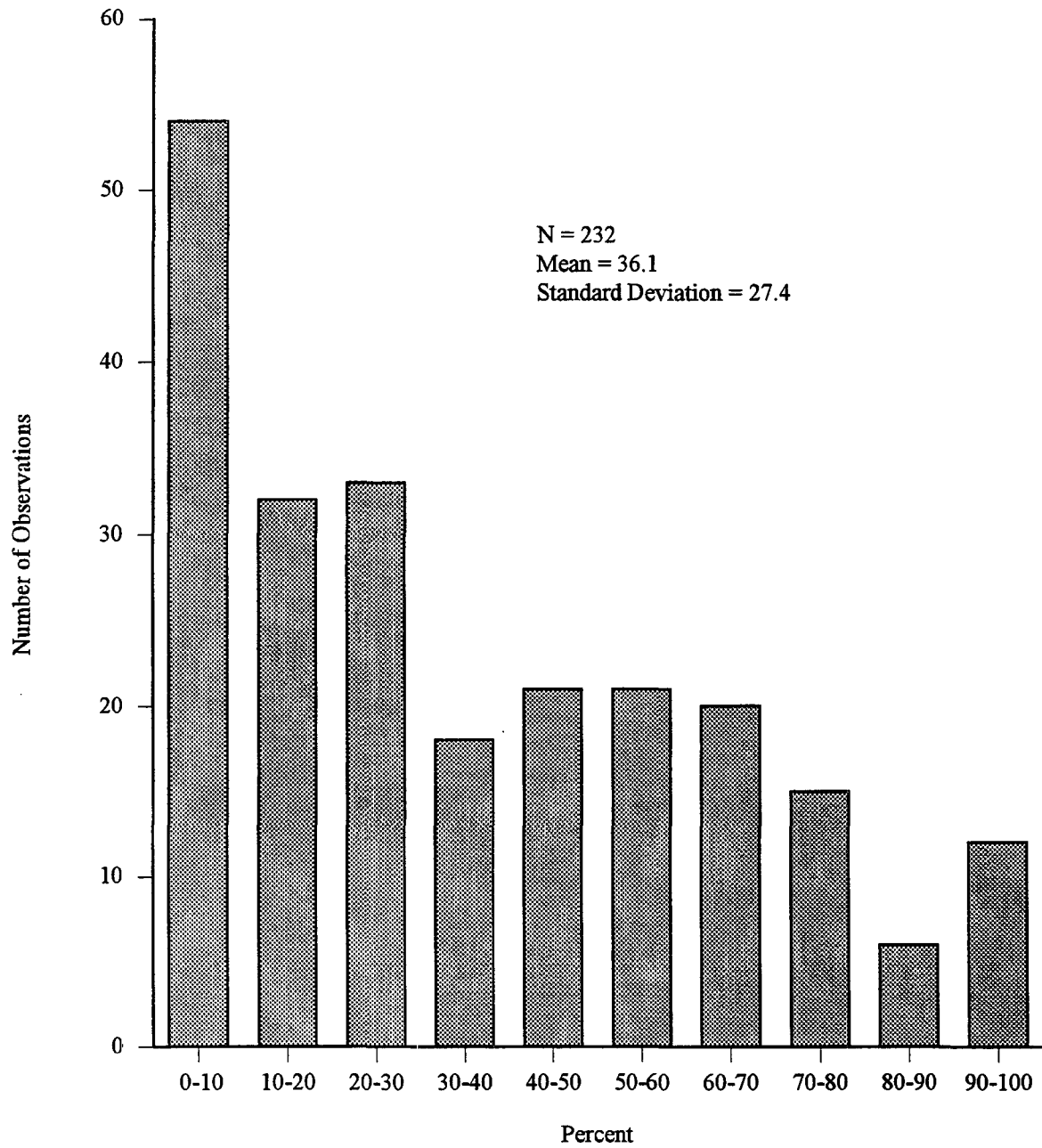
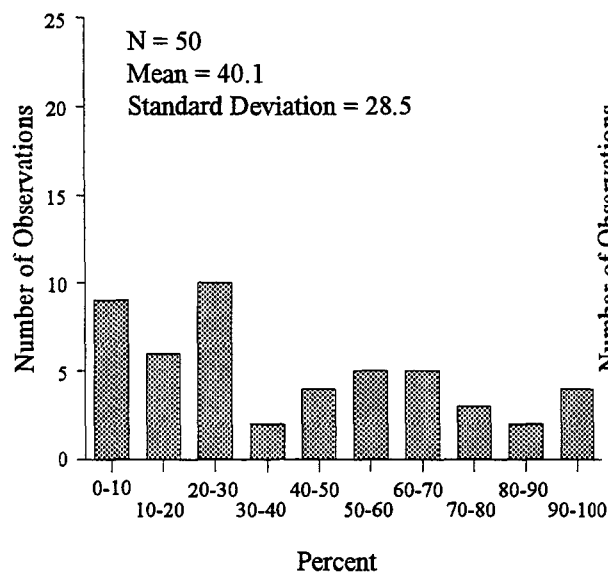
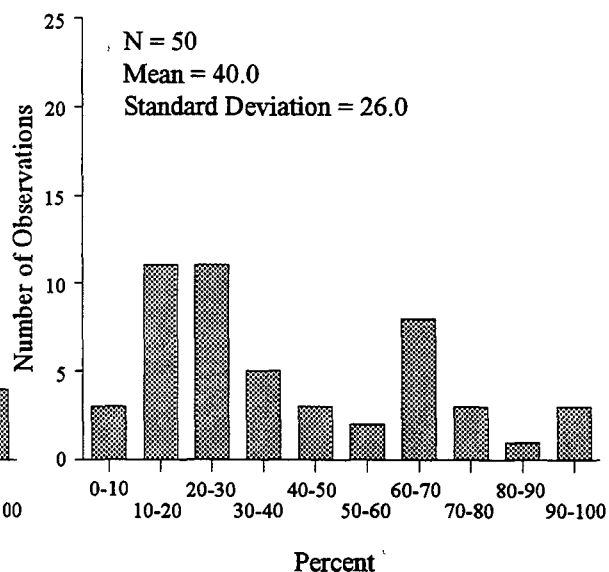


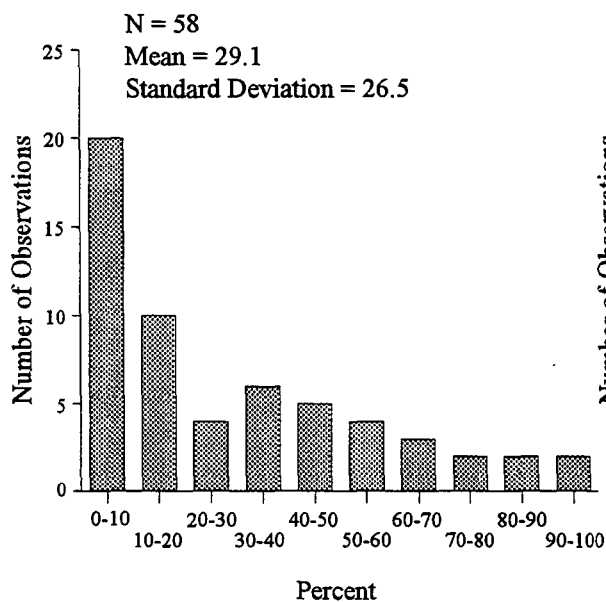
Figure 2.26. Distribution of the Subgrade Passing the Number 200 Sieve for GPS-1 Test Sections



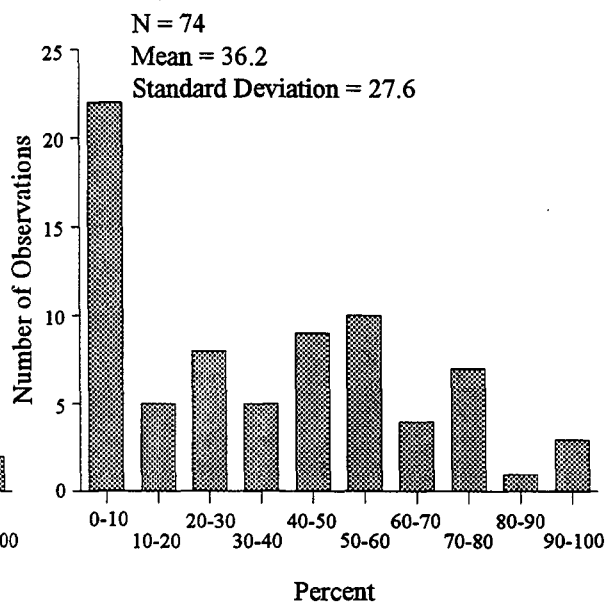
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.27. Distributions of the Subgrade Passing the Number 200 Sieve by Environmental Regions for GPS-1 Test Sections

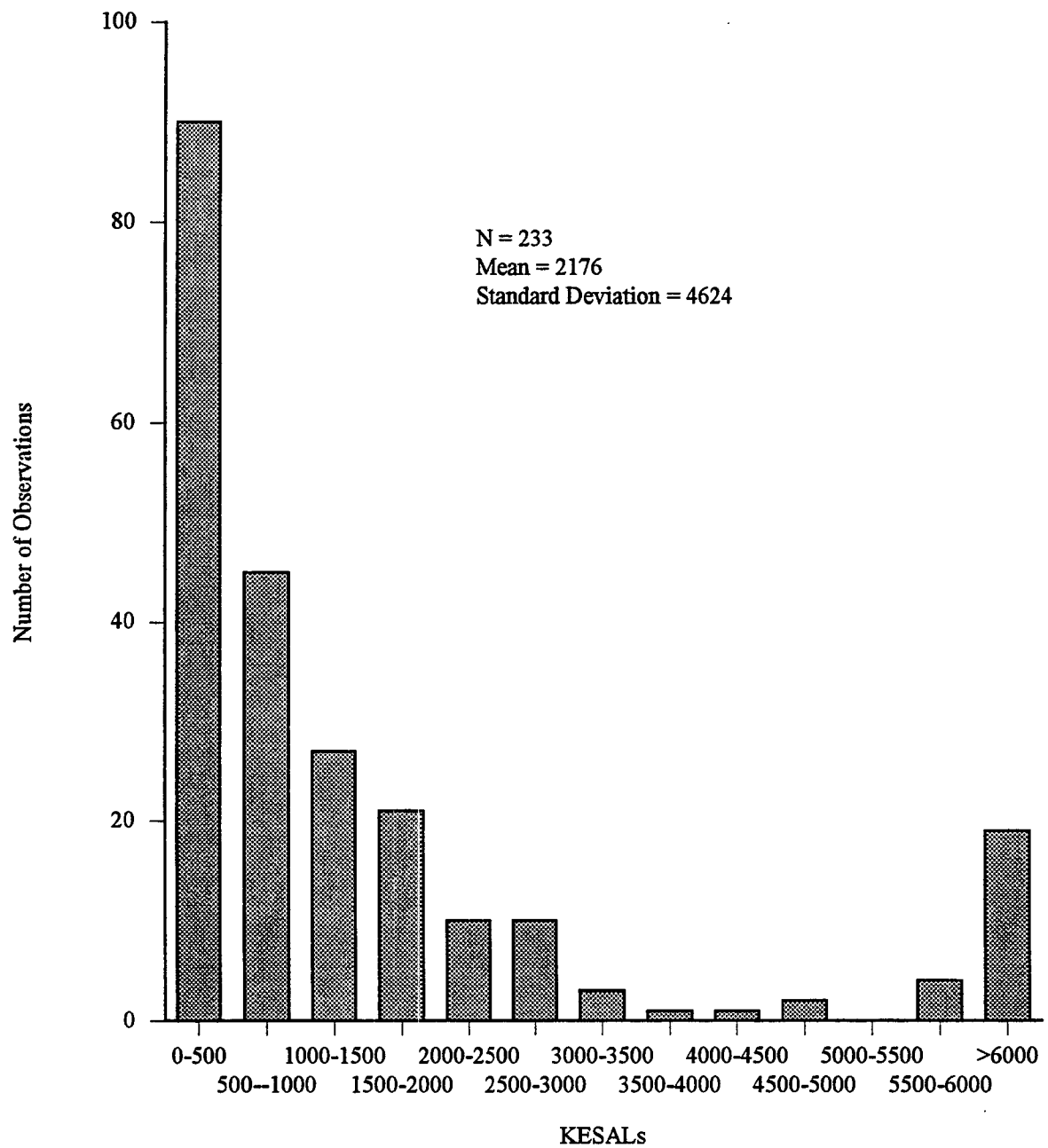
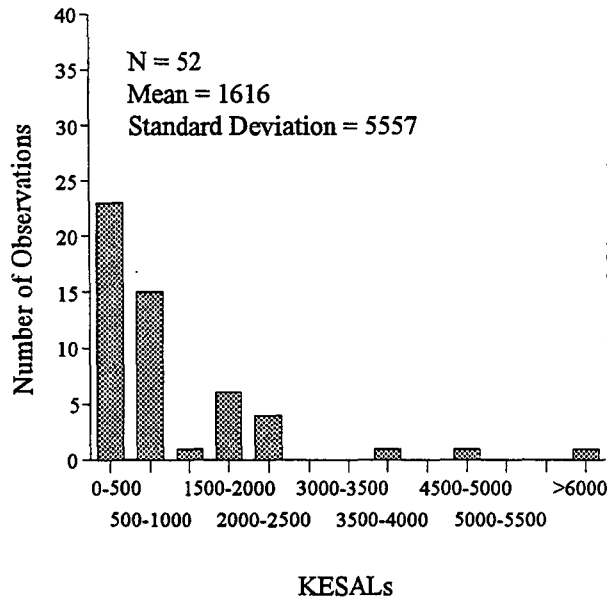
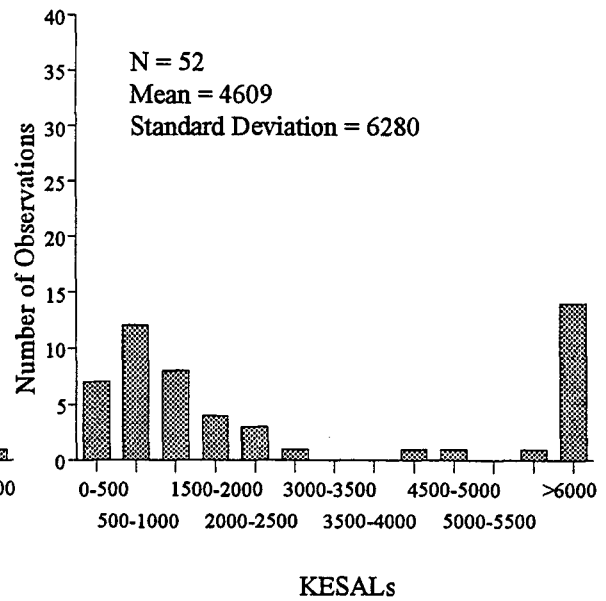


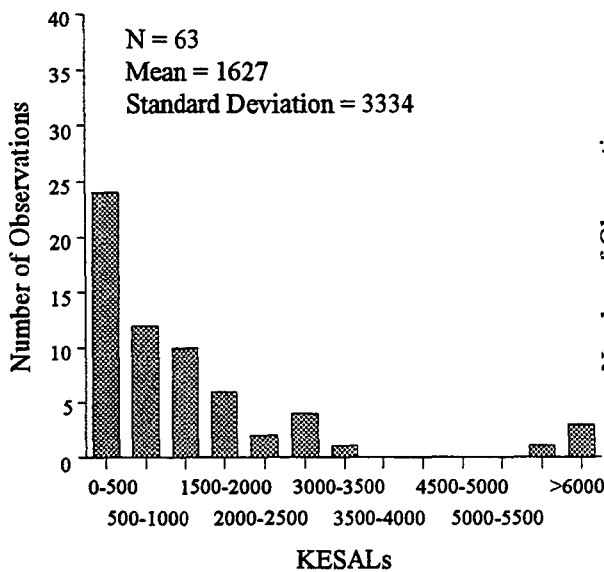
Figure 2.28. Distribution of Cumulative Equivalent Single Axle Loads in Thousands (KESALs) for GPS-1 Test Sections



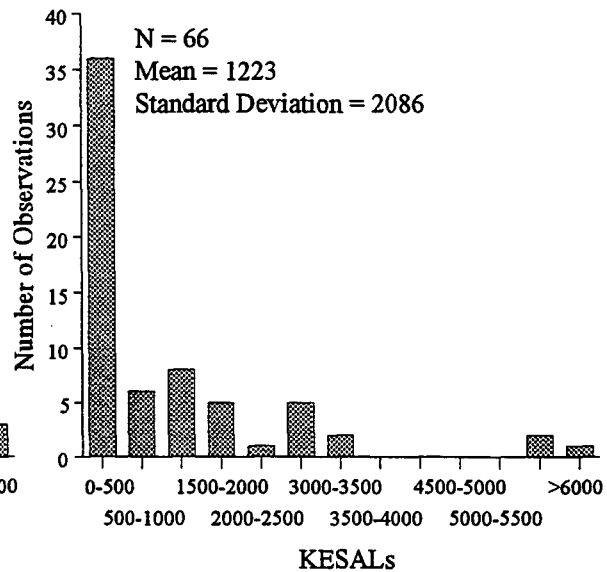
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.29. Distributions of Cumulative Equivalent Single Axle Loads in Thousands (KESALs) by Environmental Regions for GPS-1 Test Sections

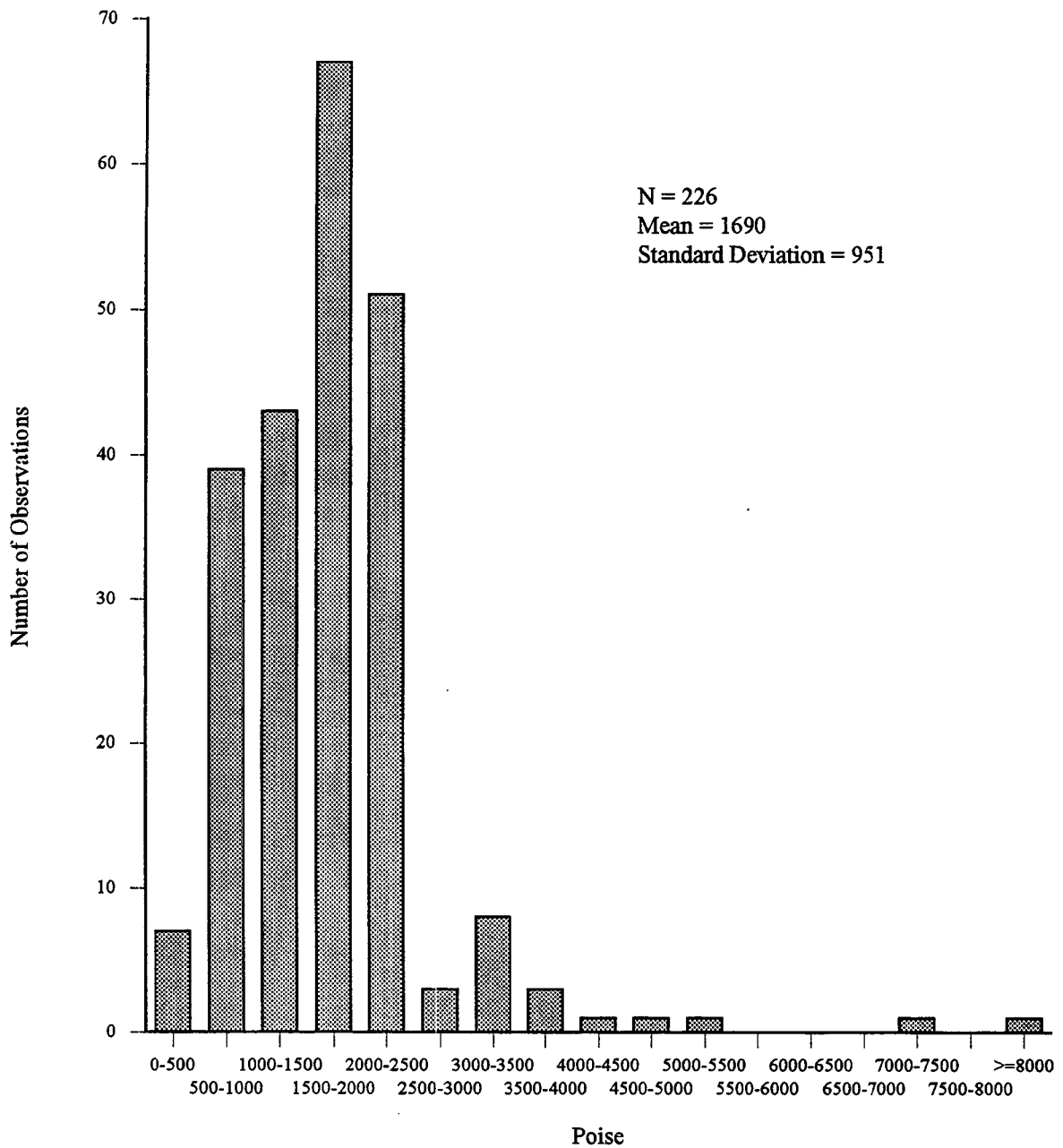
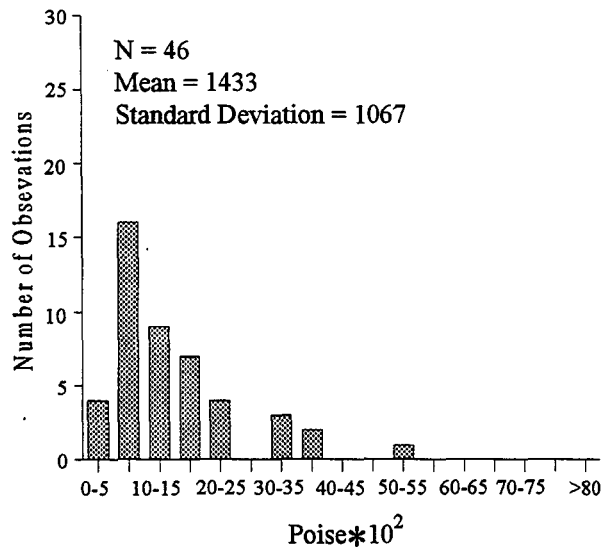
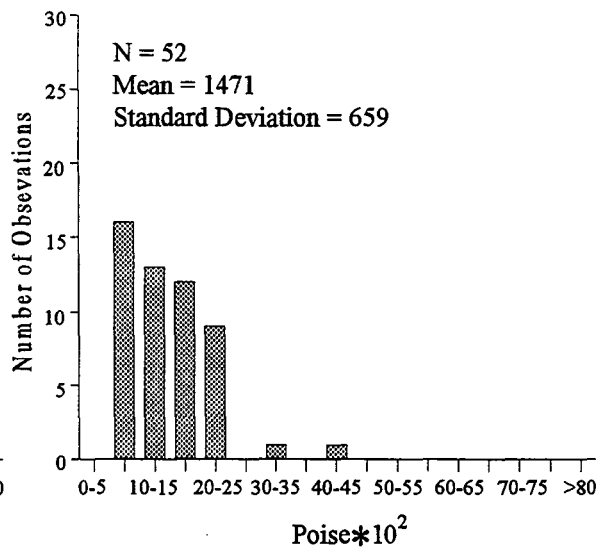


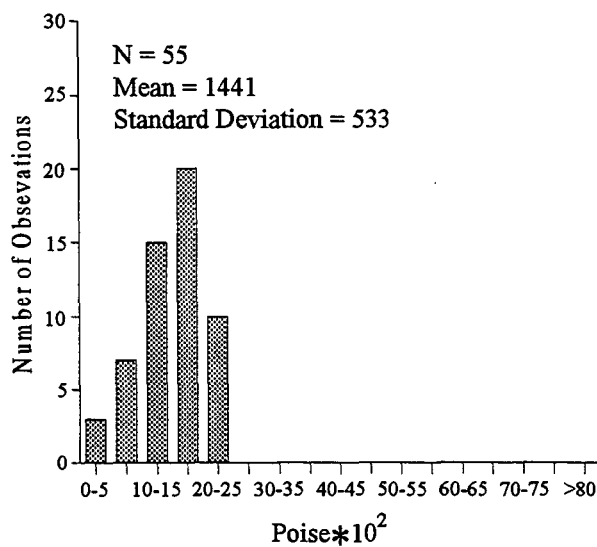
Figure 2.30. Distribution of Asphalt Cement Viscosity at 140°F for GPS-1 Test Sections



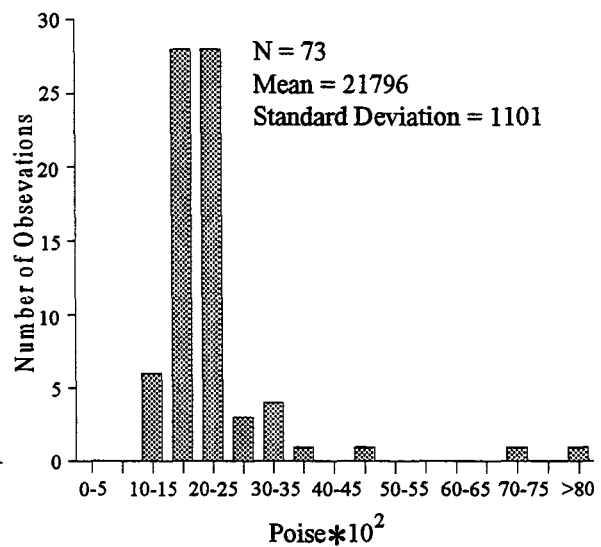
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.31. Distributions of Asphalt Viscosity at 140°F by Environmental Regions for GPS-1 Test Sections

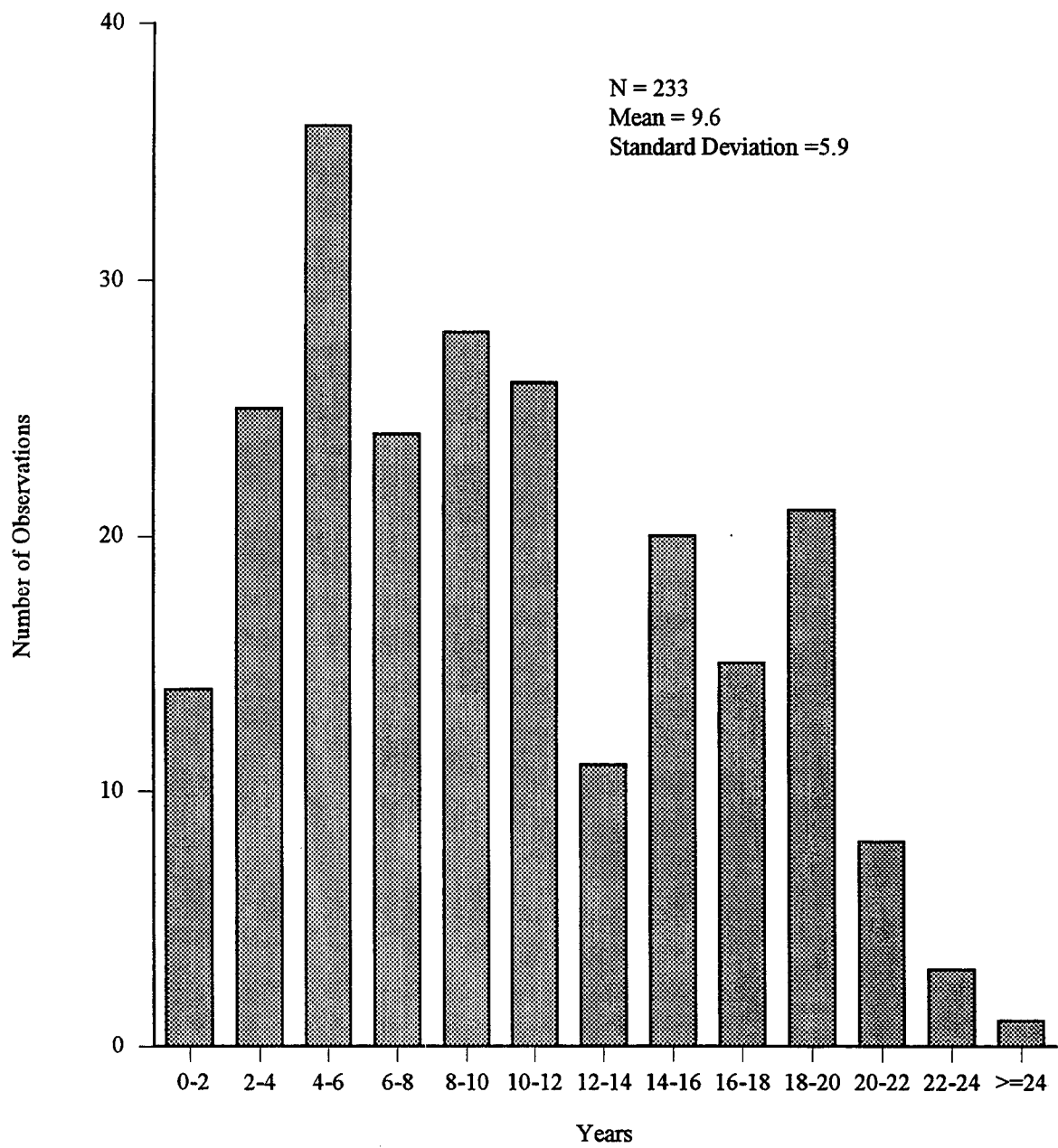
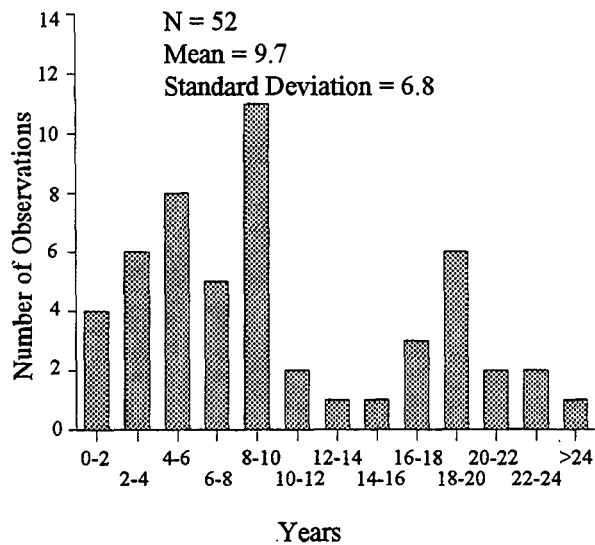
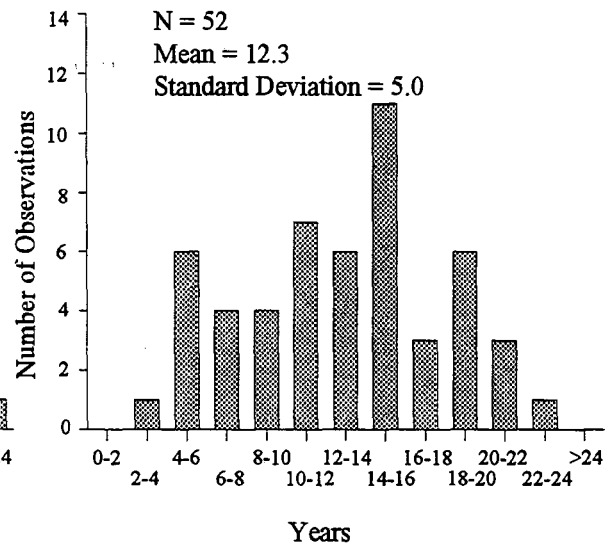


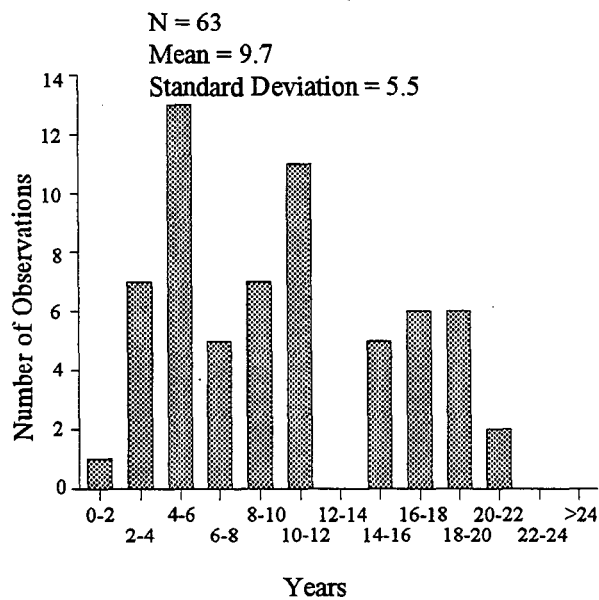
Figure 2.32. Distribution of Age for GPS-1 Test Sections



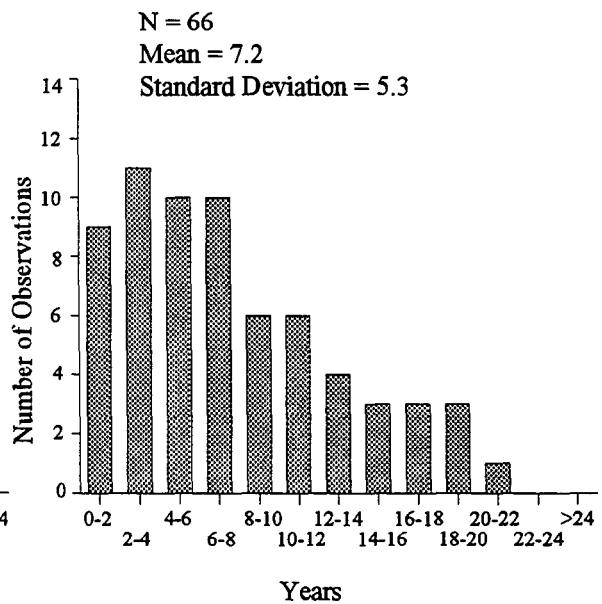
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.33. Distributions of Age by Environmental Regions for GPS-1 Test Sections

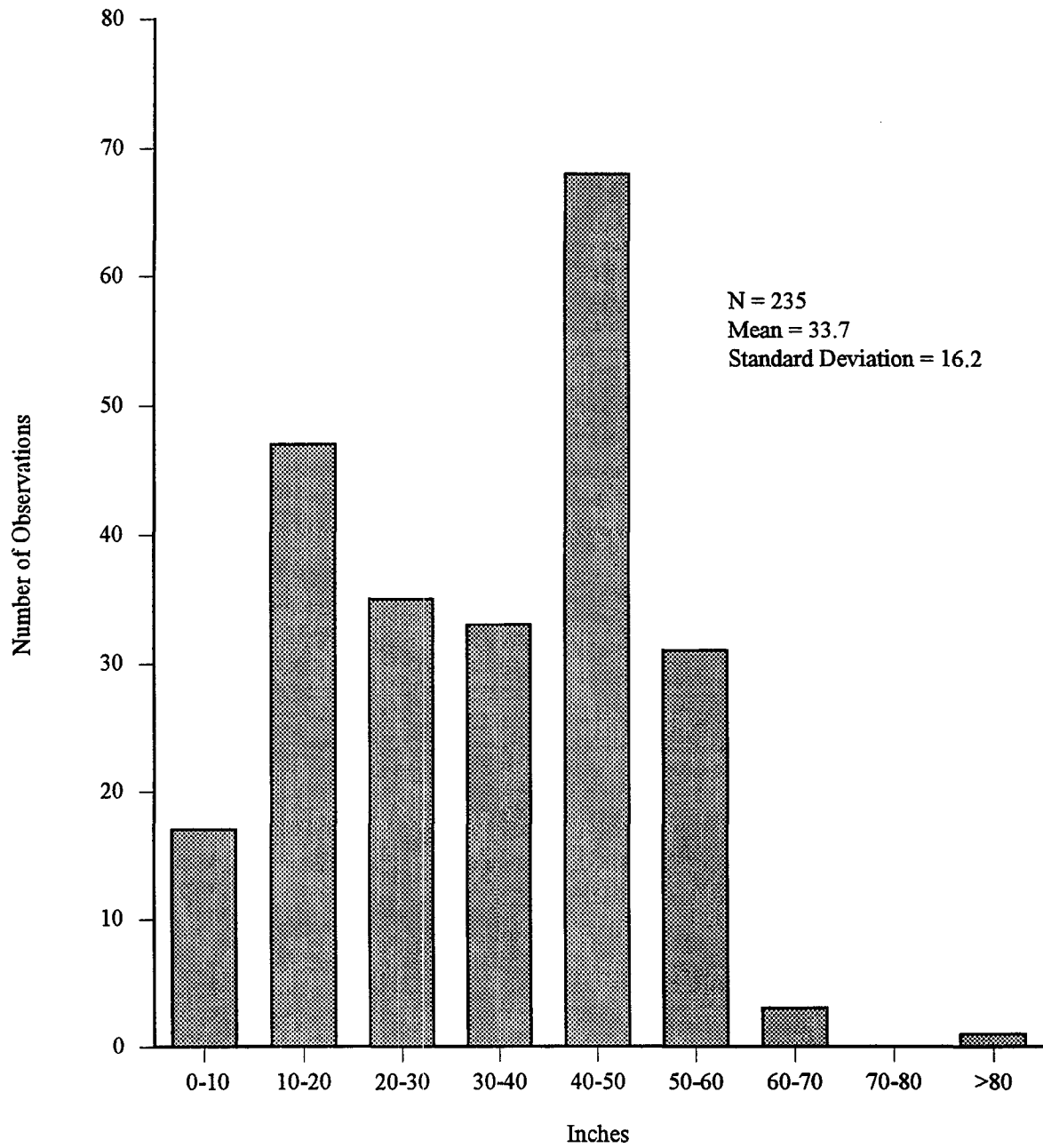
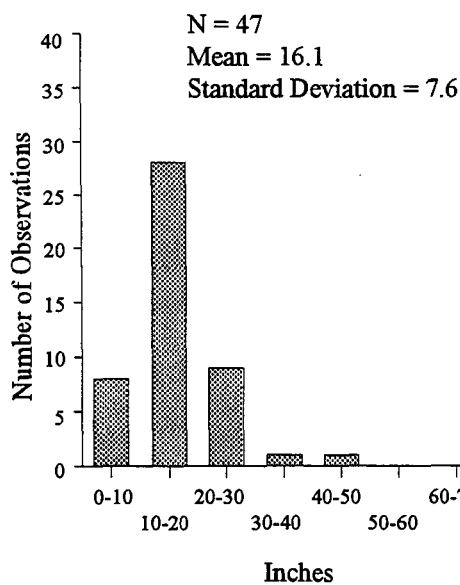
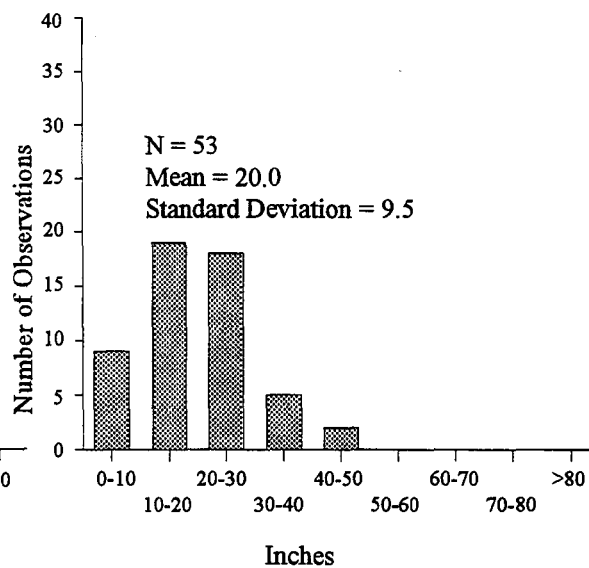


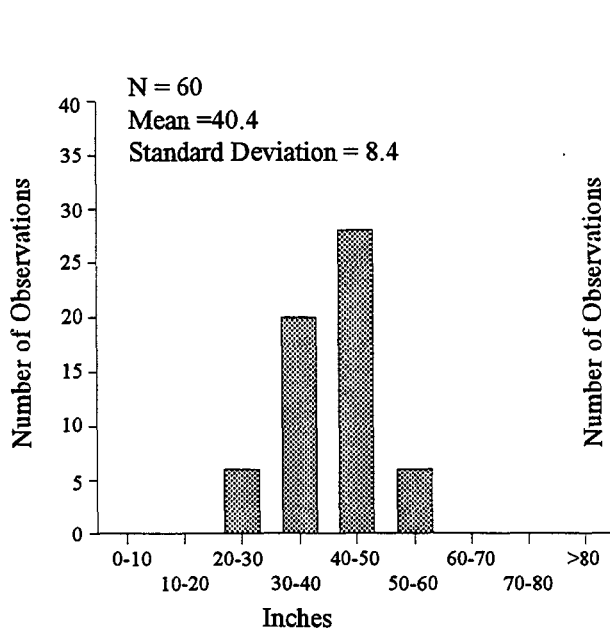
Figure 2.34. Distribution of Average Annual Precipitation for GPS-1 Test Sections



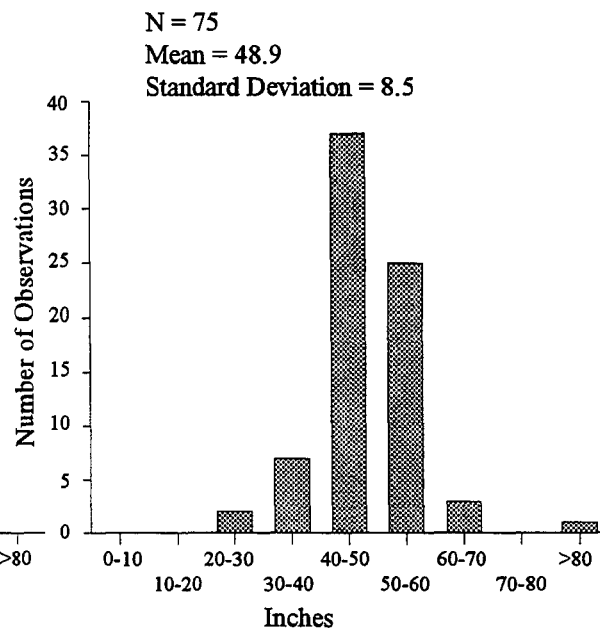
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.35. Distributions of Average Annual Precipitation by Environmental Regions for GPS-1 Test Sections

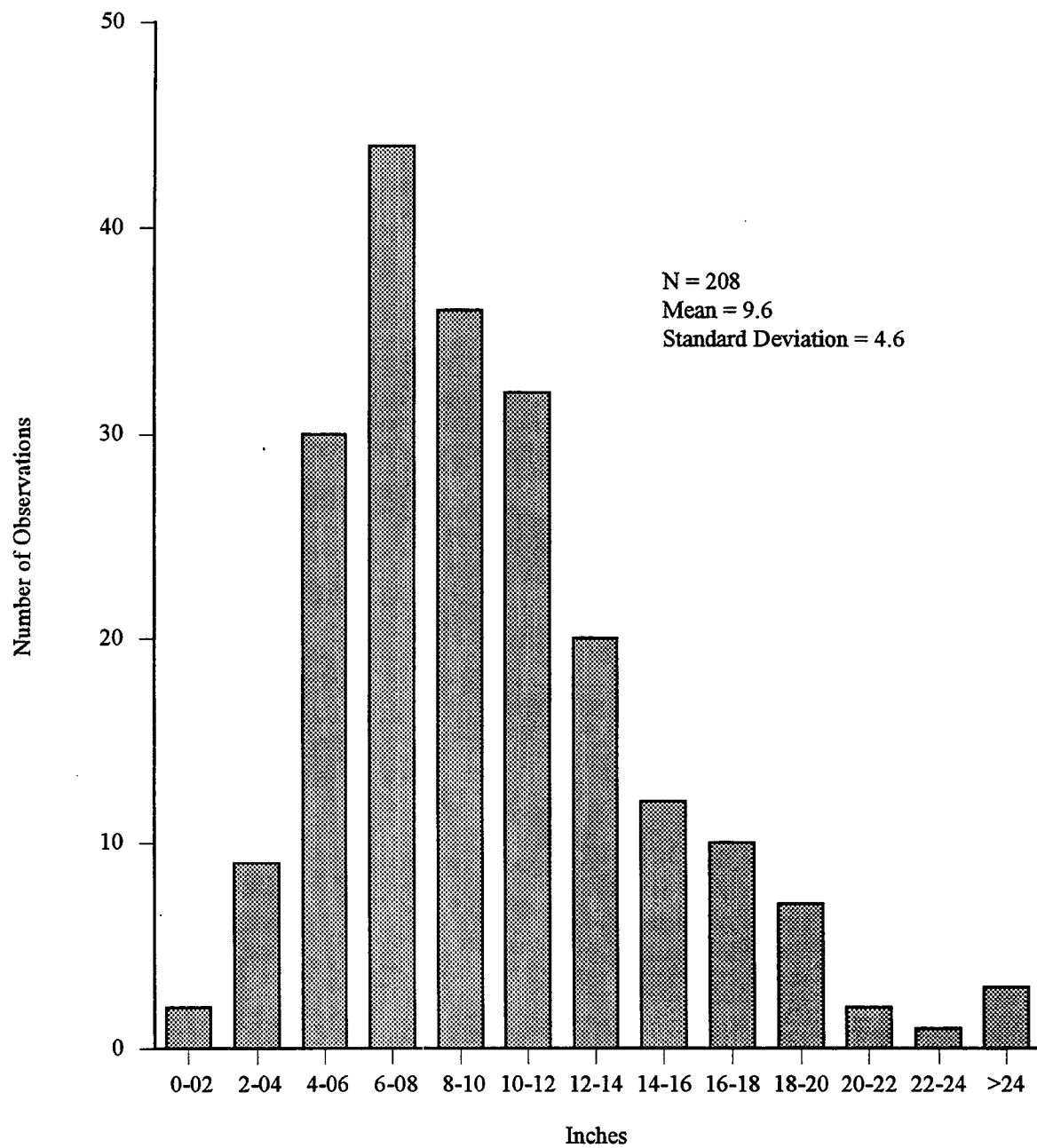
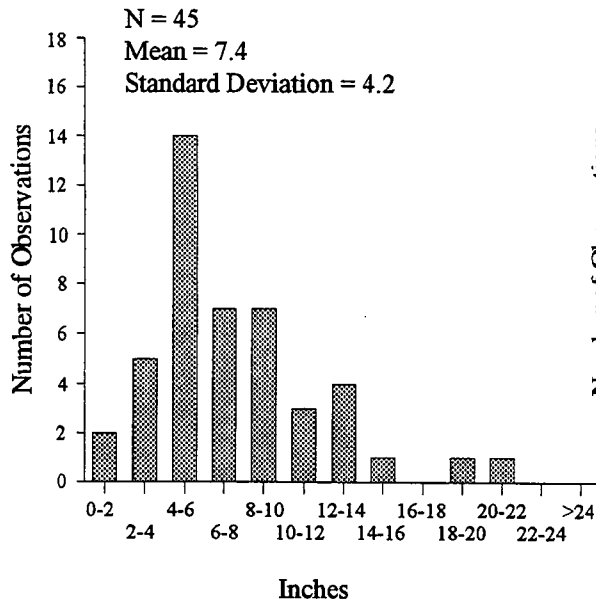
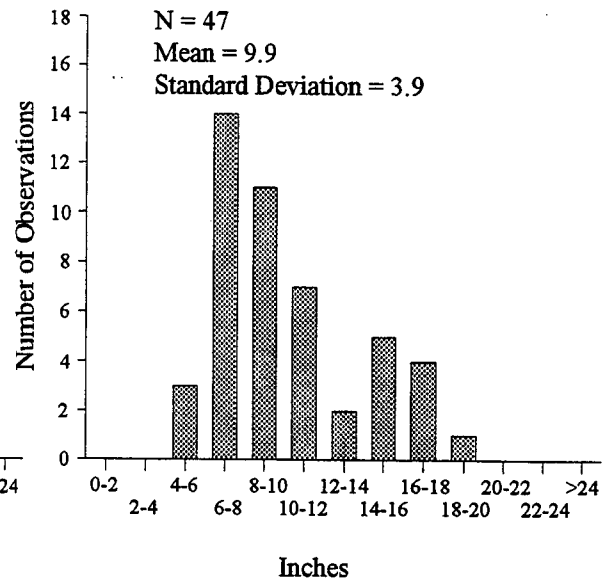


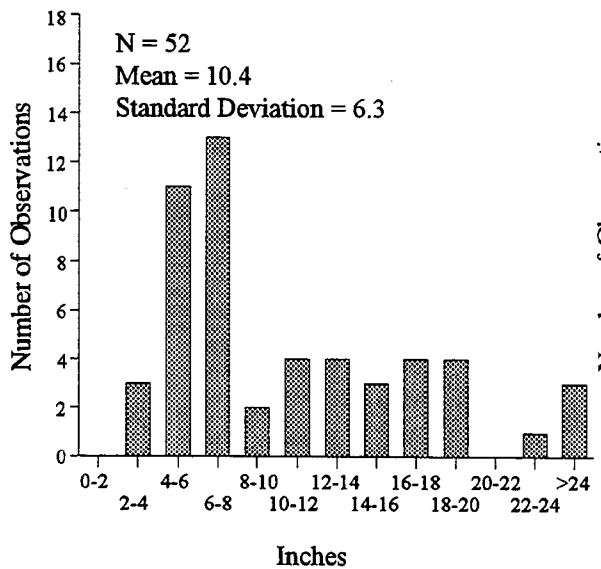
Figure 2.36. Distribution of Granular Base Thickness for GPS-1 Test Sections



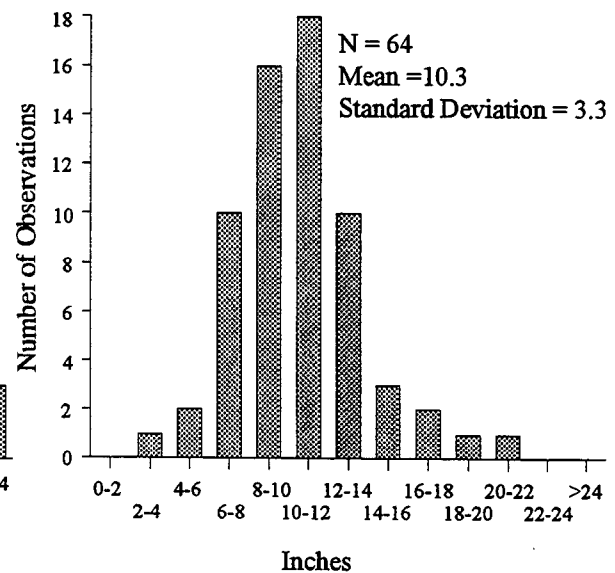
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.37. Distributions of Granular Base Thickness by Environmental Regions for GPS-1 Test Sections

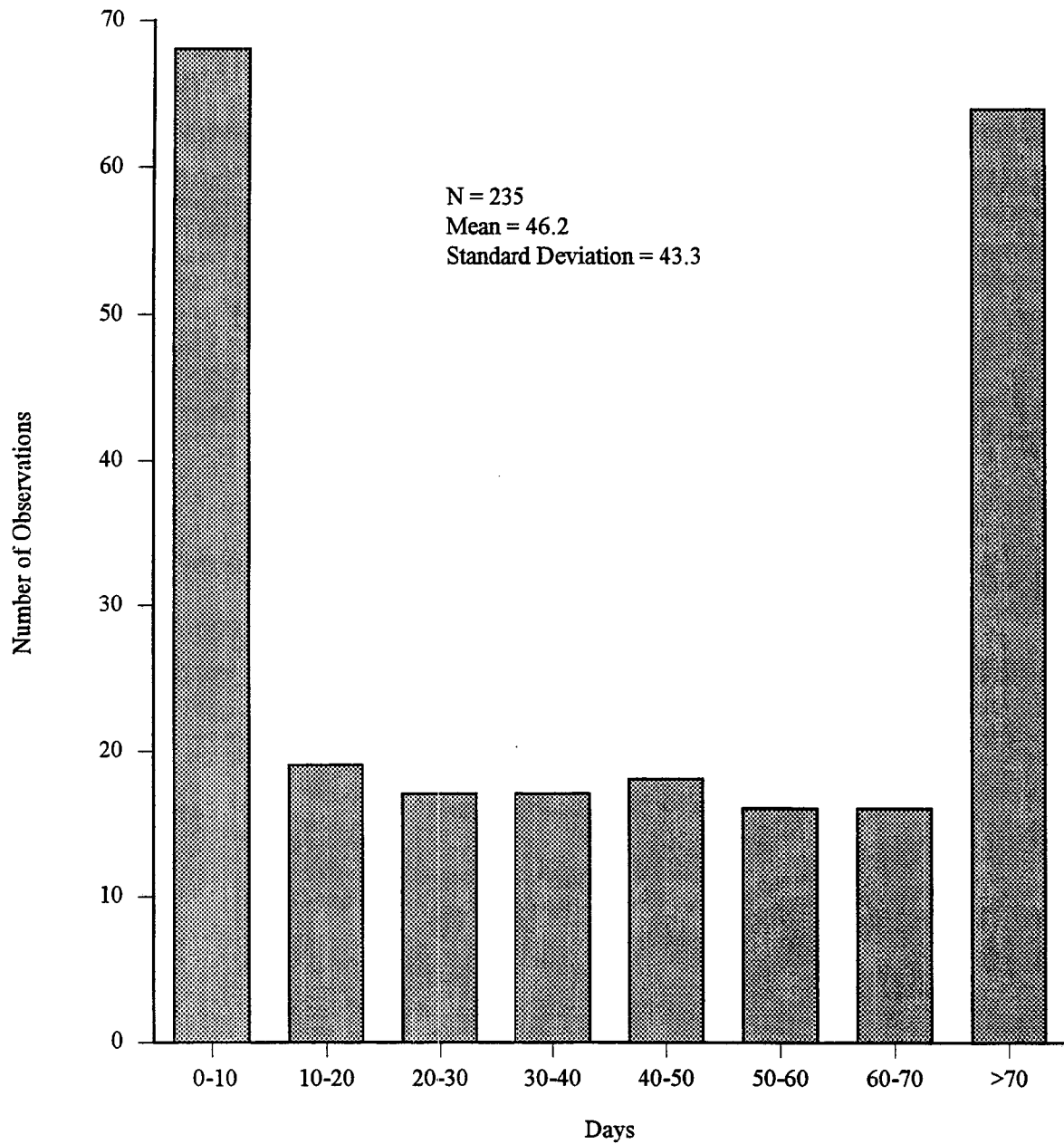
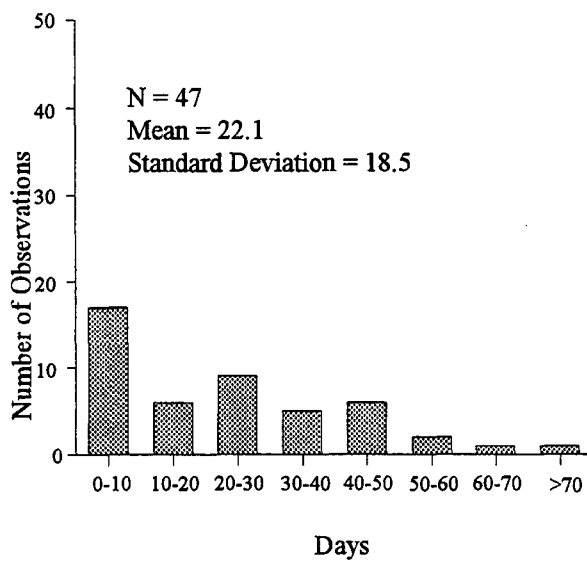
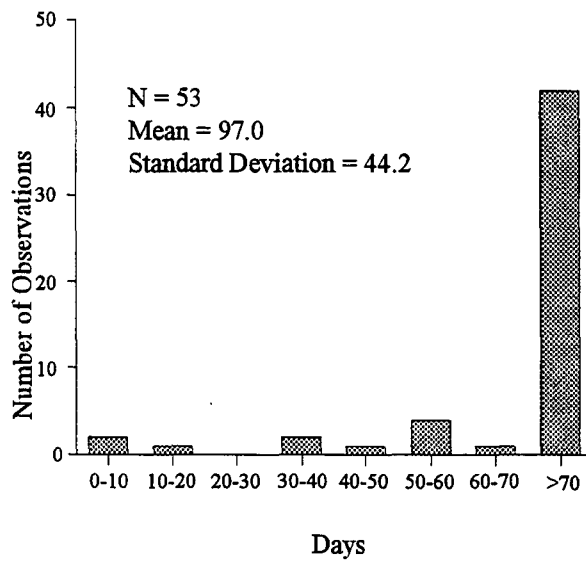


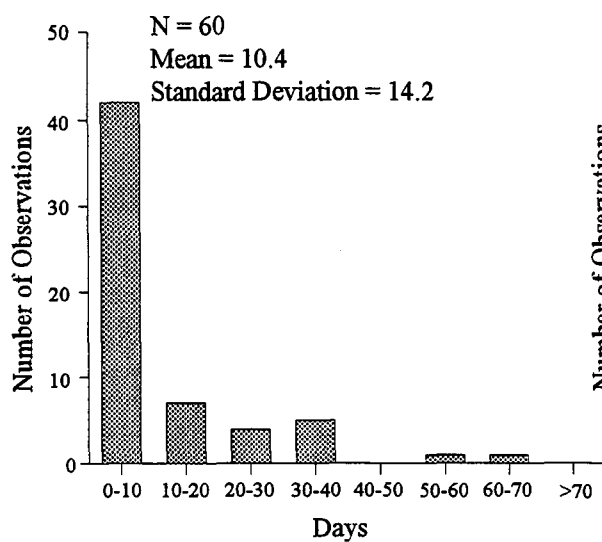
Figure 2.38. Distribution of Annual Average Number of Days Greater Than 90°F for GPS-1 Test Sections



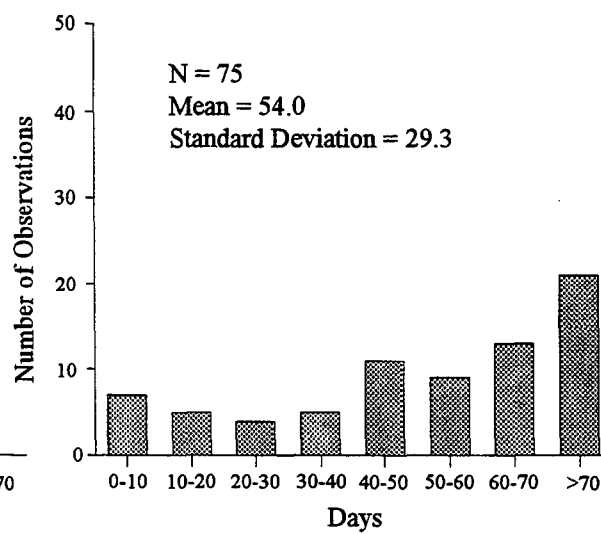
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.39. Distributions of the Average Annual Number of Days Greater Than 90°F by Environmental Regions for GPS-1 Test Sections

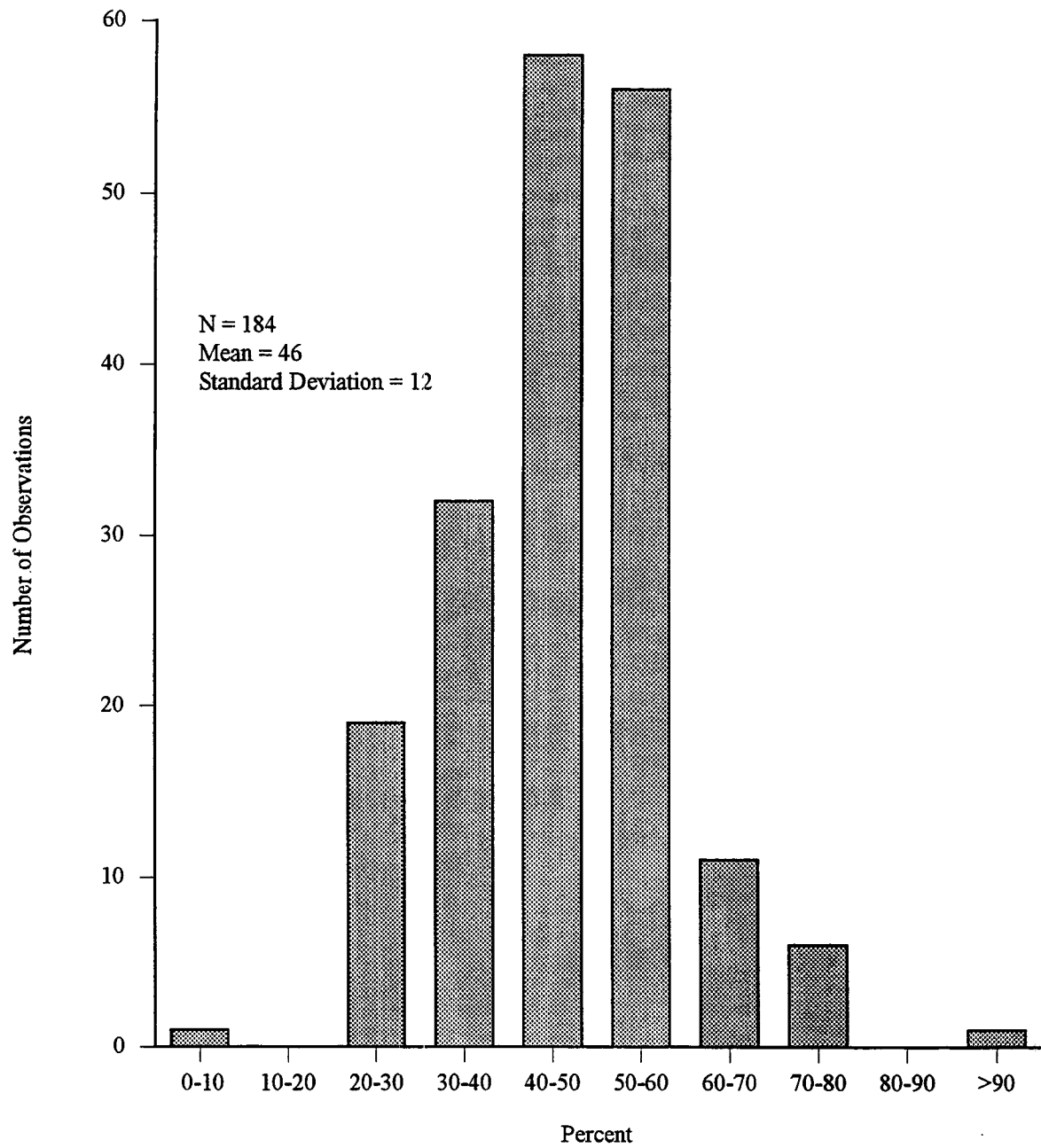


Figure 2.40. Distribution of Friction Number for GPS-1 Test Sections

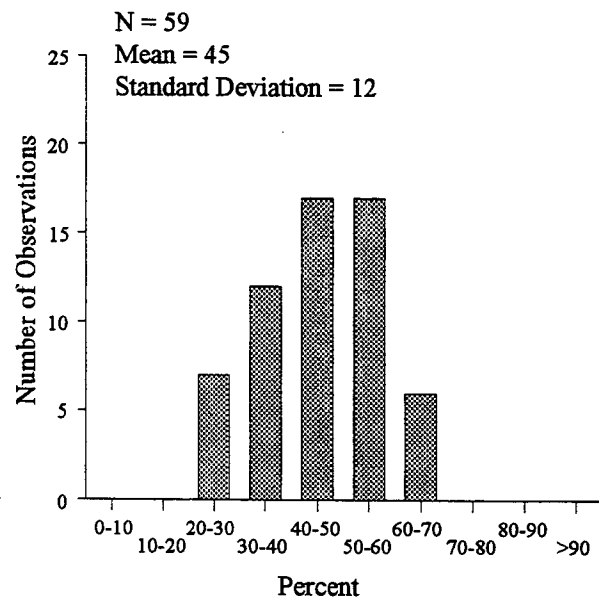
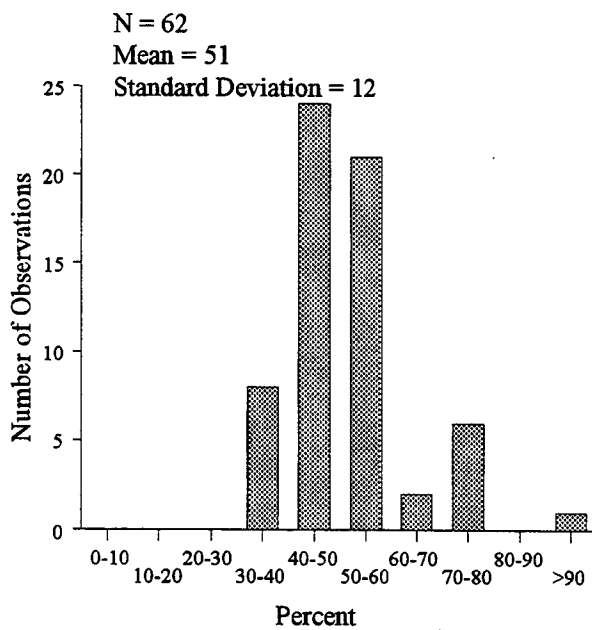
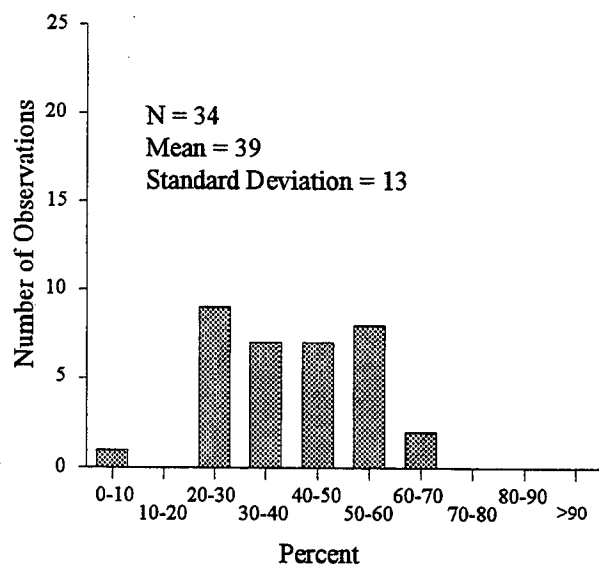
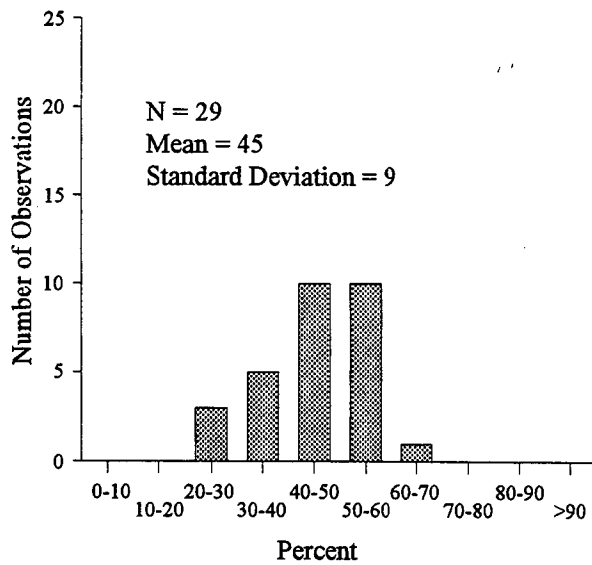


Figure 2.41. Distributions of Friction Number by Environmental Regions for GPS-1 Test Sections

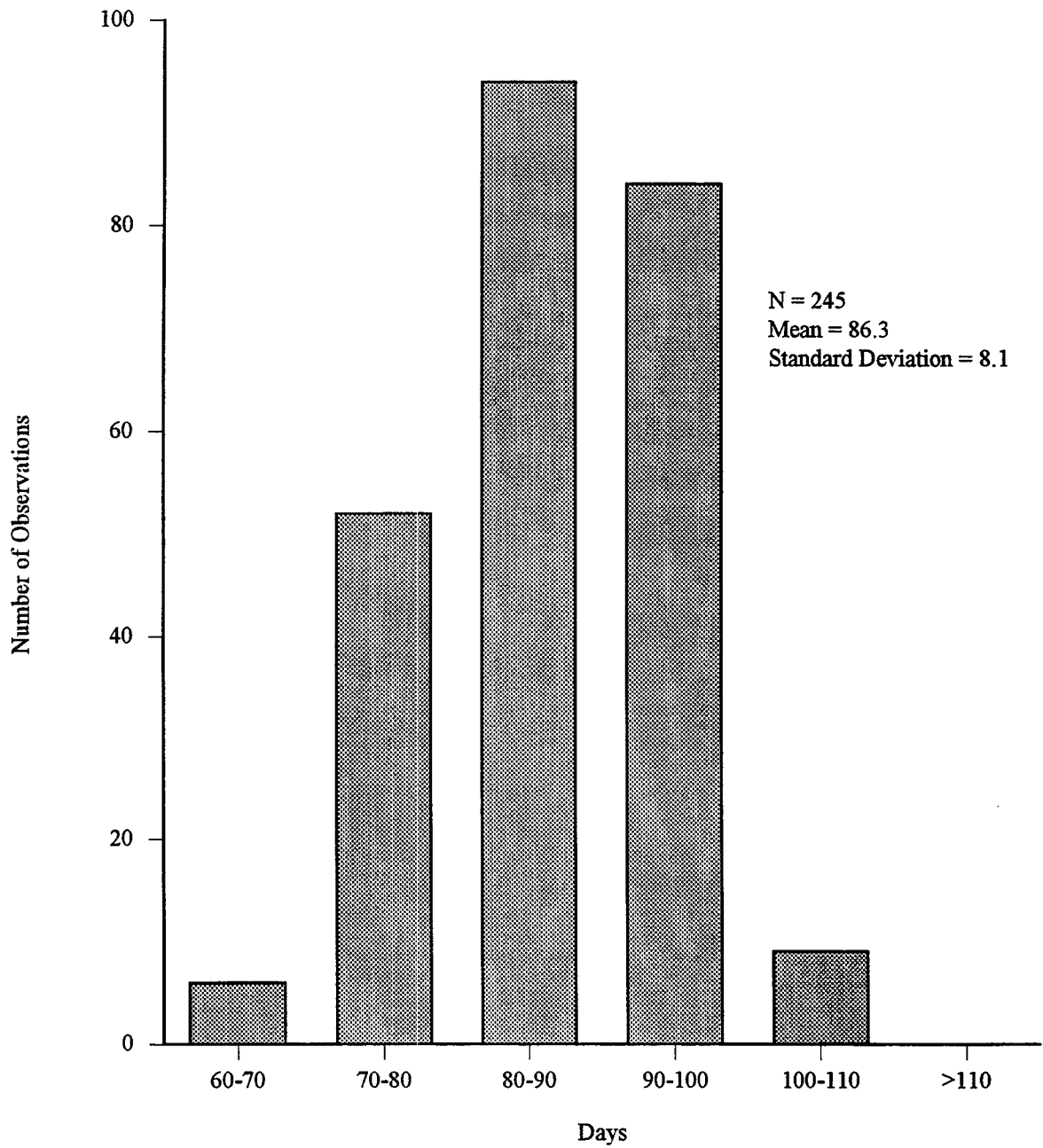
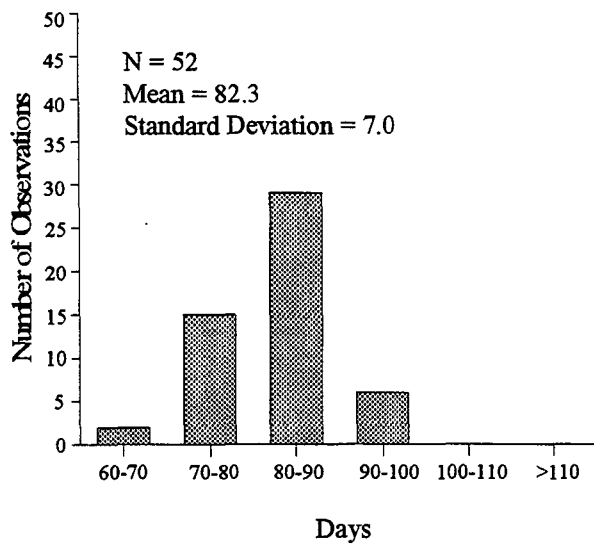
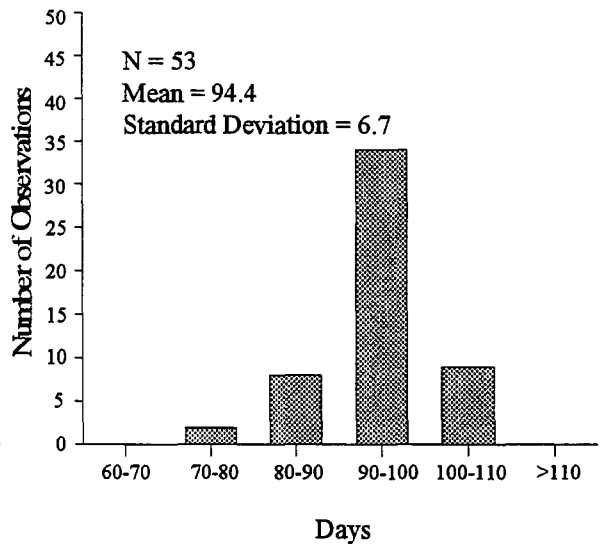


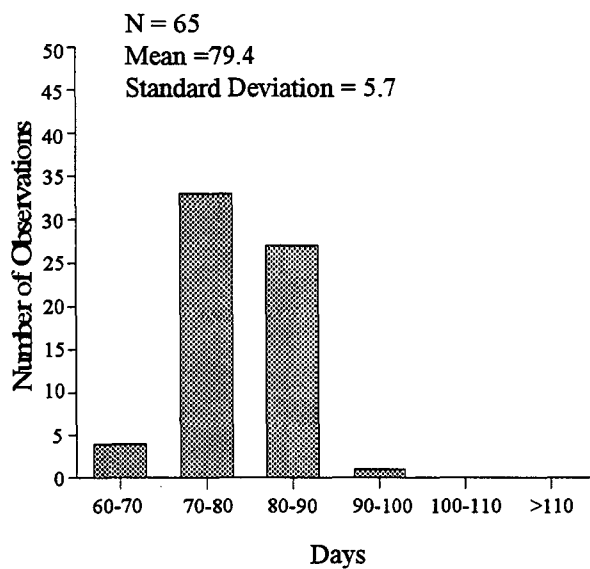
Figure 2.42. Distribution of Average Annual Maximum Temperature (for the Months of June, July and August) for GPS-1 Test Sections



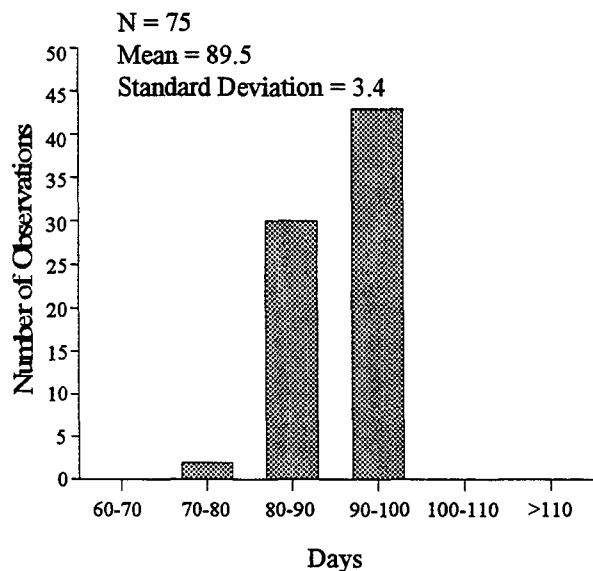
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.43. Distributions of Average Annual Maximum Temperature (for the Months of June, July and August) by Environmental Regions for GPS-1 Test Sections

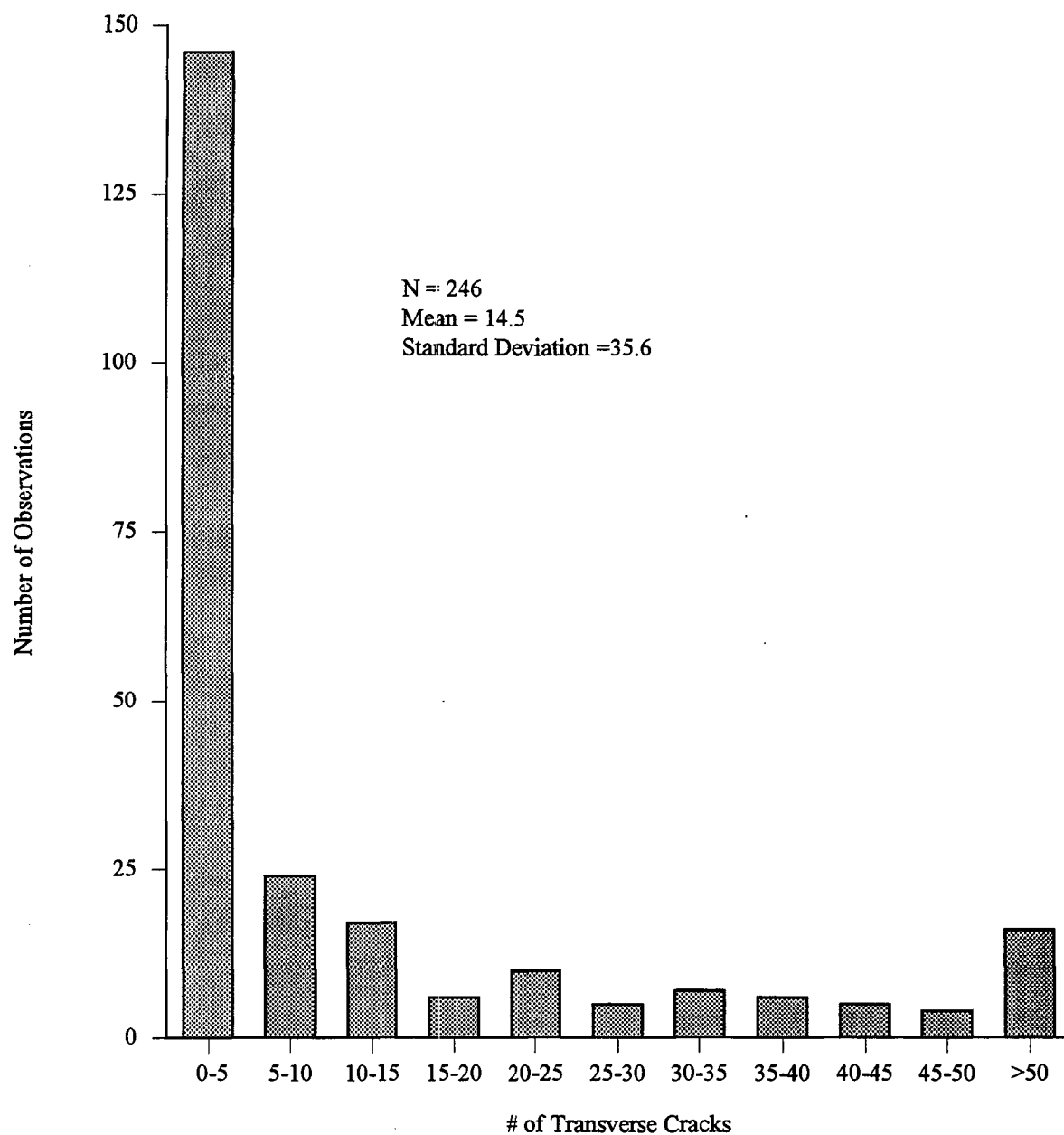
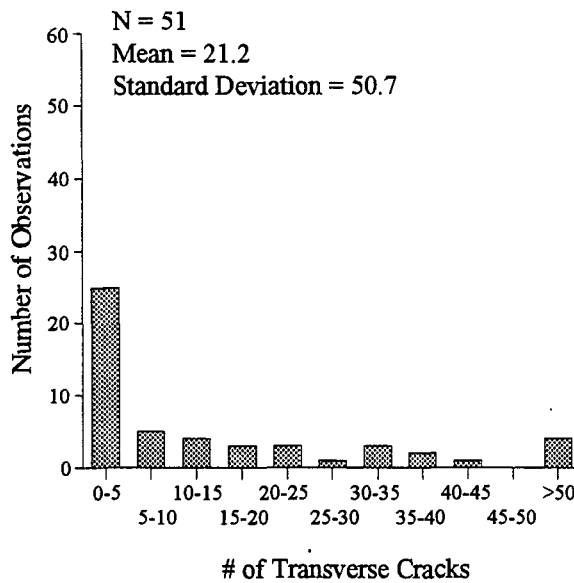
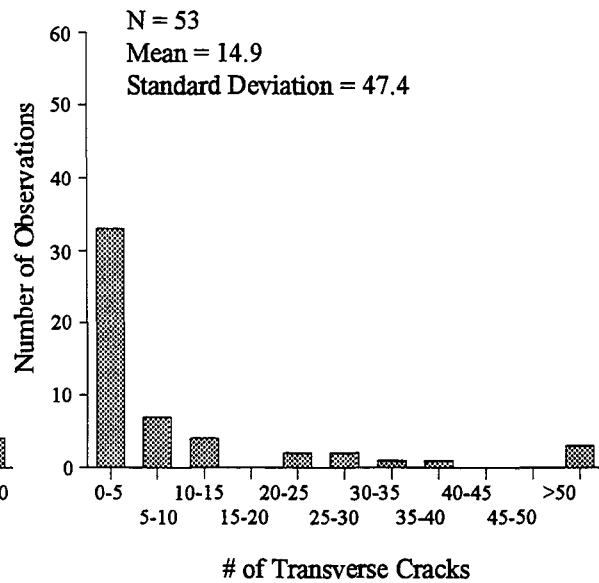


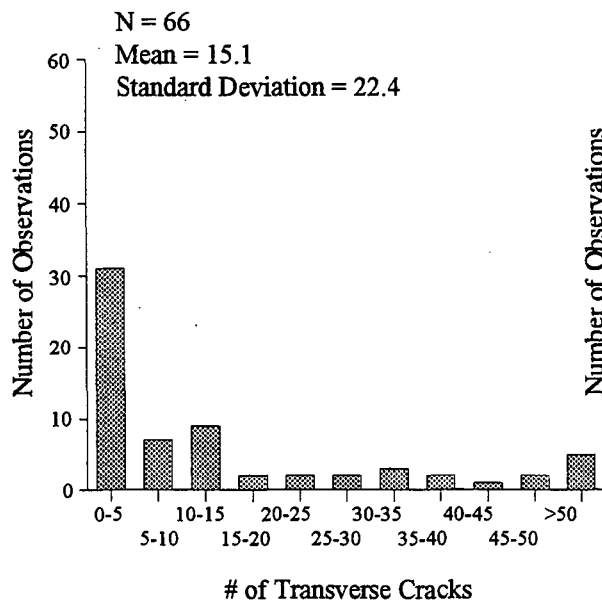
Figure 2.44. Distribution of the Number of Transverse Cracks for GPS-1 Test Sections



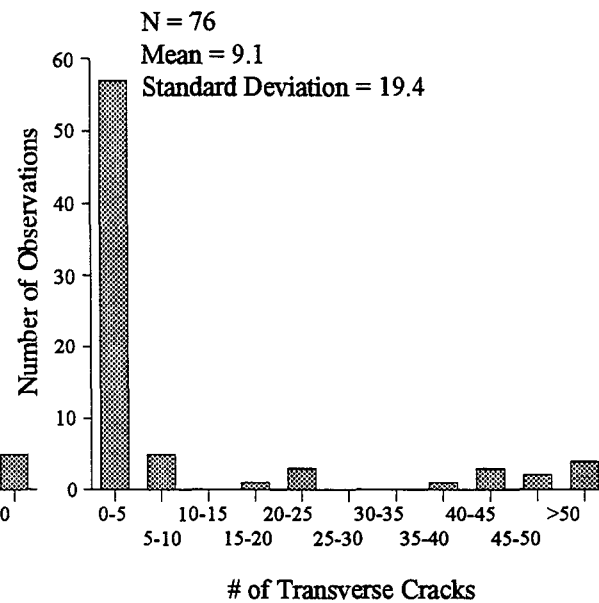
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.45. Distributions of Number of Transverse Cracks By Environmental Regions for GPS-1 Test Sections

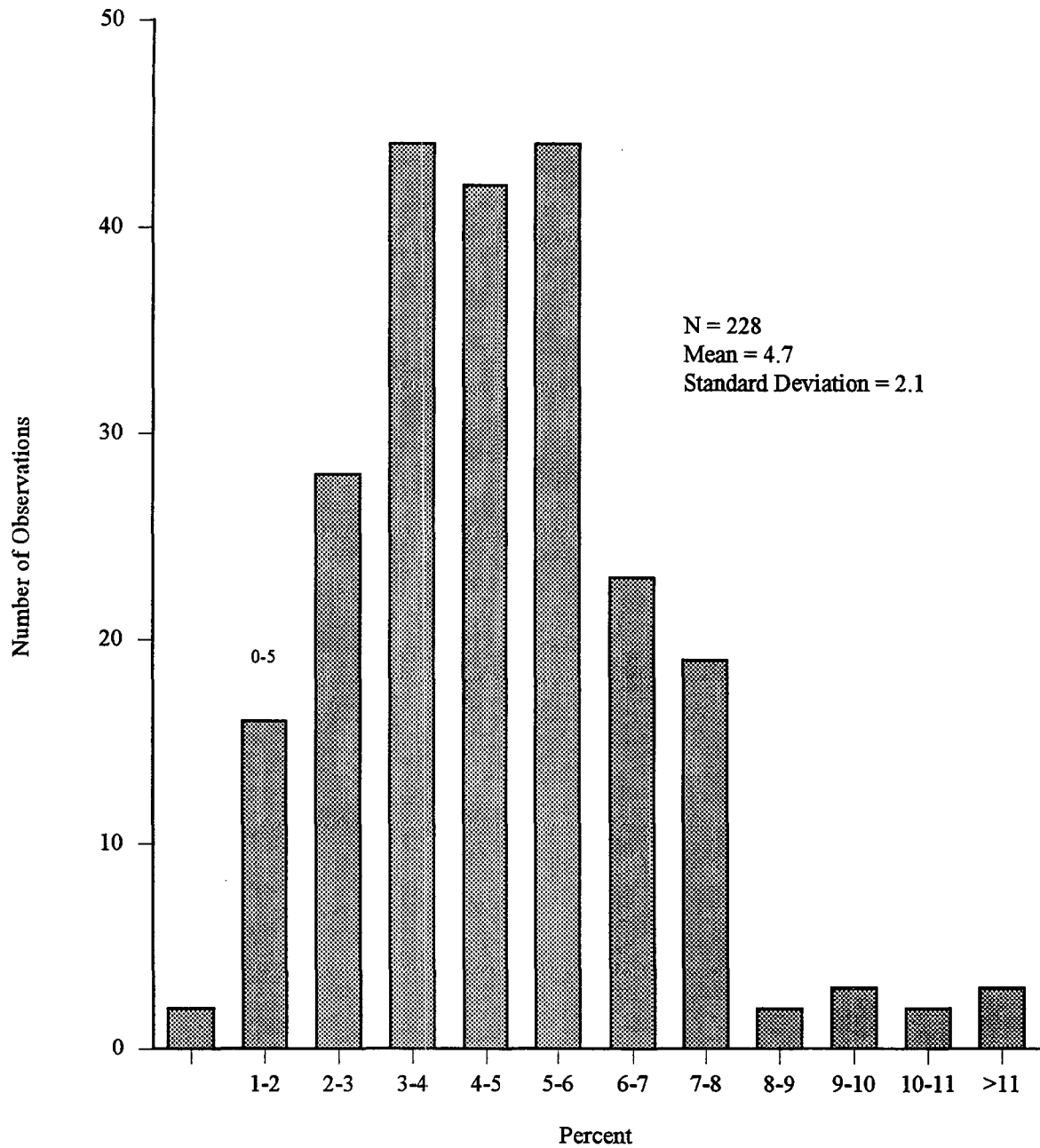
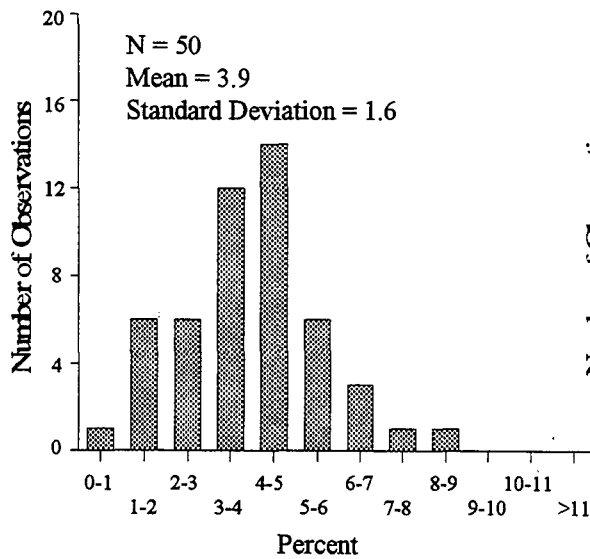
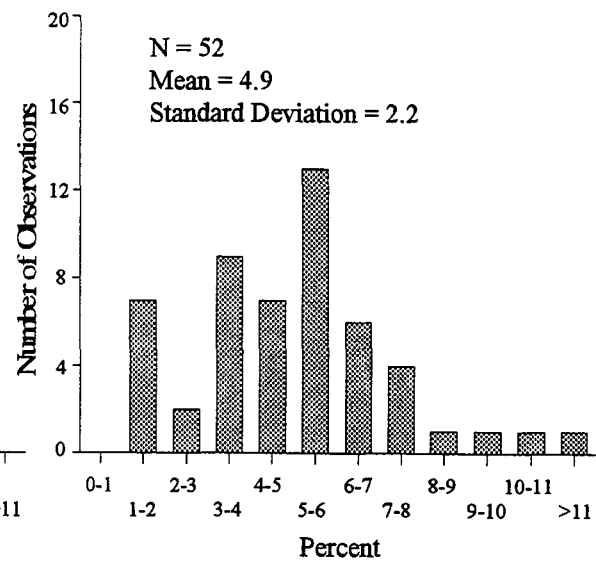


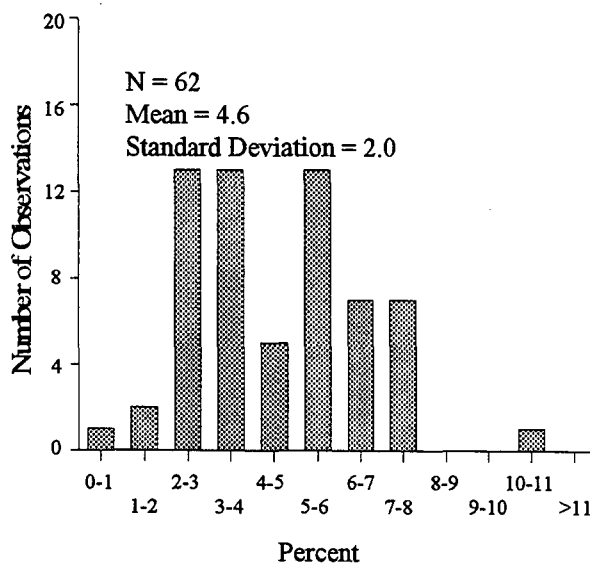
Figure 2.46. Distribution of HMAC Air Voids for GPS-1 Test Sections



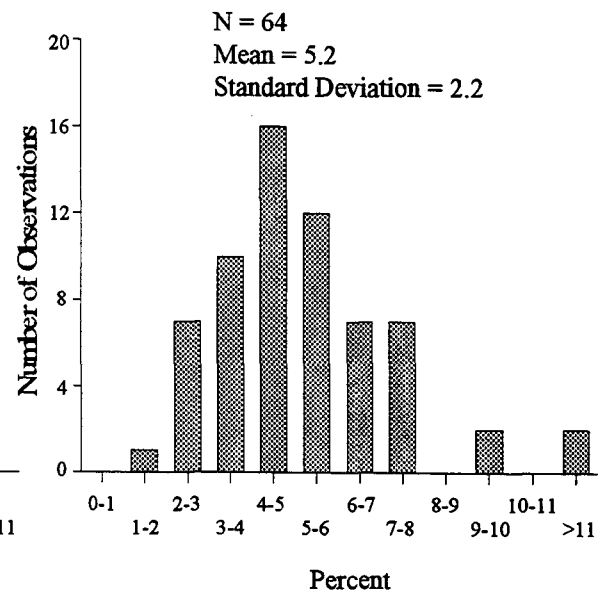
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 2.47. Distributions of HMAC Air Voids by Environmental Regions for GPS-1 Test Sections

Statistical Data for the GPS-2 Test Sections in the LTPP Data Base

This chapter provides statistical data for the 128 GPS-2 test sections for which data were available in the LTPP Data Base. See the section entitled "Statistical Data" in Chapter 1 for a description of the statistical data included in the following tables and figures.

Figure 3.1 illustrates the experimental design for GPS-1. Refer to figure 2.2 for definition of the environmental variables. The other design factors are summarized below.

Traffic Rate:	Low - Less than or equal to 85 KESAL/Yr. High - Greater than 85 KESAL/Yr.
Surface Thickness:	Low - Less than or equal to 4.5 in (110 mm). High - Greater than 4.5 in (110 mm).
Base Thickness:	Low - Less than to 8.0 in (200 mm). High - Greater than or equal to 8.0 in (200 mm).
Binder Type:	Bituminous Treated Non-Bituminous Treated

MOISTURE TEMPERATURE SUBGRADE TYPE TRAFFIC RATE SURFACE THICKNESS BASE THICKNESS BINDER TYPE				WET								DRY							
				Freeze				No Freeze				Freeze				No Freeze			
				Fine		Course		Fine		Course		Fine		Course		Fine		Course	
				Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Bituminous	Low	Low	4		3	2	5	4	2	2	1			2	2	2	1		
		High	1	1	1		1	1	1		2	1		2				1	
	High	Low	2			1	1	1	2	3	2	2				1			
		High	2		1		2	2	1	2						1		2	
Non-Bituminous	Low	Low					3	2	2				1	1			1	1	
		High	2	2	2	1	2	3	3	2	1				1		1		
	High	Low	3	1			4	1	2	2	1	1	2	1		3	1	1	
		High	2		1	1	1	4	1	1		2				2		1	

Figure 3.1. Numbers of Test Sections for Each Cell in the GPS-2 Sampling Template

**Table 3.1 Statistical Values of Interest for Significant Variables in the GPS-2 Data Set
(130 Test Sections With Distress Data Entered in IMS)**

Variable	Units	No. of Values	Mean Value	Standard Deviation	Low Value	Median Value	High Value	Range
Transverse Cracking: Low Severity:	No. Cracks	127	13.8	22.9	0	2	122	122
	Lin. Ft.	127	88.9	144.0	0	4.1	697	697
	Moderate Severity:	No. Cracks	1.6	4.7	0	0	39	39
		Lin. Ft.	15.5	42.0	0	0	260	260
	High Severity:	No. Cracks	0.5	4.3	0	0	48	48
		Lin. Ft.	5.0	51.0	0	0	573	573
Alligator Cracking: Low Severity:	Square Ft.	127	19.7	92.4	0	0	640	640
	Moderate Severity:	Square Ft.	6.1	33.3	0	0	246	246
		Square Ft.	0.4	4.7	0	0	53	53
Raveling & Weathering: Low Severity:	Square Ft.	127	53.7	383.1	0	0	3500	3500
	Moderate Severity:	Square Ft.	28.2	310.6	0	0	3500	3500
		Square Ft.	0	0	0	0	0	0

Note: Statistical values only reflect data for those test sections found to have the distress of interest present.

Table 3.2. Statistical Values of Interest for Significant Variables in the GPS-2 Data Set

Variable	Units	No. of Values	Mean Value	Standard Deviation	Low Value	Median Value	High Value	Range
Rut Depth (6')	Inches	116	0.23	0.12	0.07	0.19	0.65	0.58
Initial Roughness (IRI)	Inches/Mile	92	56	22	0	60.5	114	114
Measured Roughness (IRI)	Inches/Mile	118	77	28	31	74	184	153
Transverse Cracking: Low Severity: Moderate Severity: High Severity:	No. Cracks	127	13.8	22.9	0	2	122	122
	Lin. Ft.	127	88.9	144	0	4.1	697	697
	No. Cracks	127	1.6	4.7	0	0	39	39
	Lin. Ft.	127	15.5	42	0	0	260	260
	No. Cracks	127	0.5	4.3	0	0	48	48
	Lin. Ft.	127	5.0	51.0	0	0	573	573
Alligator Cracking: Low Severity: Moderate Severity: High Severity:	Square Ft.	127	19.8	92.4	0	0	640	640
	Square Ft.	127	6.1	33.3	0	0	246	246
	Square Ft.	127	0.4	4.7	0	0	53	53
Raveling & Weathering: Low Severity: Moderate Severity: High Severity:	Square Ft.	127	53.7	383	0	0	3500	3500.0
	Square Ft.	127	28.18	310.590	0	0	3500.0	3500
	Square Ft.	127	0	0	0	0	0	0
Measured Friction Number	%	77	46	10	22	46	92	71
Surface Thickness	Inches	116	5.3	3.0	0.7	4.6	15.3	14.6
Bound Base Thickness	Inches	110	7.2	2.7	1.8	6.6	16.4	14.6
Granular Subbase Thickness	Inches	55	10.8	8.3	0.8	7.3	40.7	39.9

Continued on Page 81

Table 3.2. Statistical Values of Interest for Significant Variables in the GPS-2 Data Set

Variable	Units	No. of Values	Mean Value	Standard Deviation	Low Value	Median Value	High Value	Range
Treated Subbase Thickness	Inches	16	6.4	2	4.5	6.0	13.1	8.6
Age of Pavement	Years	121	10.1	6.2	1.0	9.0	25.0	24.0
Cumulative KESALS	No.	121	2172	3464	37	673	14757	14719.7
Asphalt Viscosity @ 140F - Surface	Poise	112	1996	848	326	1993	6957	6631
Asphalt Content - Surface	% by wt.	116	5.0	0.8	3.2	5.0	6.8	3.6
Air Voids - Surface	% by wt.	110	5.2	2.3	0.91	5.2	12.7	11.8
HMAC Aggregate Passing #4 Sieve - Surface	% by wt.	113	55.8	11.4	0	55.3	100	100
Asphalt Viscosity @ 140F - Bit. Base	Poise	21	1940	301	1168	2000	2613	1445
Asphalt Content Bit. Base	% by wt.	21	4.5	1.2	2.4	4.5	7.4	5.0
Air Voids - Bit. Base	% by wt.	21	7.2	3.9	3.20	6.3	16.9	13.7
Emulsion	% by wt.	4	4.6	1.3	3.0	4.8	5.8	2.8
% Cement - Cement Treated Base	% by wt.	61	5.9	1.8	3.0	6.0	10.0	7.0
Compaction of Subbase (Mod. AASHTO)	%	38	93.2	6.91	76.7	95.4	103.8	27.1
In Situ Moisture in Subgrade	% by wt.	113	13.3	6.8	2.7	12.5	38.4	35.8
Subgrade Soil Passing #200 Sieve	% by wt.	111	41.6	25.6	0.9	40.0	95.2	94.3
Plasticity Index of Subgrade	%	113	7.9	8.6	0	6	45	45

Table 3.2. Statistical Values of Interest for Significant Variables in the GPS-2 Data Set

Variable	Units	No. of Values	Mean Value	Standard Deviation	Low Value	Median Value	High Value	Range
Liquid Limit of Subgrade	%	113	20.4	16.5	0	24	65	65
Subgrade Soil Finer than 0.02 mm	%	107	29.1	18.3	2.6	25.2	82.0	79.5
Freeze Index	°F-Days < 32F	122	392.1	598.6	0	150	3133	3133
No. of Days Min. Temp. < 32°F	No.	122	81.7	57.5	0	72	206	206
No. of Days Max. Temp. > 90°F	No.	122	45.1	32.8	0	41	159	159
Number of Air Freeze-Thaw Cycles	No.	122	70.3	41.9	0	71	170	170
Annual Precipitation	Inches	122	39.7	17.8	5.9	44.3	71.3	65.4
Average Daily Temp. Range	°F	128	23.7	4.1	11.5	23.6	34.4	22.9
Avg. Annual Min. Temp. (Daily Min. Temps. for Dec., Jan., and Feb.)	°F	128	27.8	11.7	-3.9	28.0	64.0	67.9
Avg. Annual Max. Temp. (Daily Max. Temps. for June, July and Aug.)	°F	128	87.2	6.8	65.2	88.9	106.0	40.8
Avg. Min. Temp. by Month	°F	115	44.9	9.9	5.9	46.2	66.9	61.0
Avg. Max. Temp. by Month	°F	115	68.57	9.92	25.7	70.6	87.5	61.8

Table 3.3. Description of Variables Used in the Correlation Matrix for the GPS-2 Data Set

Variable	Description of Variable
MEAN6	Rut Depth (6-ft. straight edge), inches
I_IRI	Initial IRI value, inches/mile
B_IRI	Measured IRI value, inches/mile
TCRK_T	Total measured Transverse cracking (all severity levels combined) in linear feet
TNO_T	Total number of Transverse cracks identified (all severity levels combined)
AGE	Age of pavement, years
KESALs	Equivalent Single Axle Loads in thousands
SURTH	Surface thickness, inches
TBTHK	Treated Base thickness, inches
GSBTH	Granular Subbase thickness, inches
V140	Asphalt cement viscosity @ 140°F, poise
A_CON	Asphalt Content of surface course, % by weight
AV	Air Voids of surface course, % by weight
% 4	Percent Passing the #4 sieve for surface course, by weight
A_CONB	Asphalt Content of the Base, % by weight
AVB	Air Voids of the Base, % by volume
% 200	Percent passing the #4 sieve for the subgrade, by weight
MOIST	Insitu Moisture of the subgrade, % by weight
TPREC	Average Annual Precipitation, inches
AVG90	Average number of days with temperature greater than 90°F
AVG32	Average number of days with temperature less than 32°F
FTIN	Freeze Index, degree days
FRZTH	Average number of Freeze-Thaw Cycles
%CEM	Portland Cement Content of Base, % by weight

Table 3.4. Correlation Analysis for Significant Variables in the GPS-2 Data Set (SAS Format)

Pearson Correlation Coefficients/Prob > |R| under Ho: Rho=0/Number of Observations

	MEAN6	I_IRI	B_IRI	TCRK_T	TNO_T	AGE	KESALS	SURTH	TBTHK	GSBTH	V140	A-CON
MEAN6	1.00000 0.0 116	0.01489 0.8944 82	0.28118 0.0029 110	0.07011 0.4545 116	0.17429 0.0613 116	0.22605 0.0181 109	0.09334 0.3344 102	0.03816 0.7034 96	-0.01136 0.9125 45	-0.11322 0.4590 98	0.06128 0.5489 102	0.08701 0.3845
I_IRI	-0.01489 0.8944 82	1.00000 0.0 92	0.01109 0.9212 82	0.26454 0.0108 92	0.21112 0.0434 86	0.02976 0.7856 86	0.11111 0.3085 86	-0.28057 0.0102 83	0.23771 0.0326 81	-0.26375 0.1147 37	-0.13710 0.2223 81	0.25130 0.0219 83
B_IRI	0.28118 0.0029 110	0.01109 0.9212 82	1.00000 0.0 118	0.36334 0.0001 118	0.35677 0.0001 118	0.25053 0.0083 110	-0.00408 0.9663 110	-0.09800 0.3223 104	0.03568 0.7273 98	-0.1116 0.9400 48	-0.01099 0.9136 100	0.02224 0.8227 104
TCRK_T	0.07011 0.4545 116	0.26454 0.0108 92	0.36334 0.0001 118	1.00000 0.0 130	0.92095 0.0001 130	0.12707 0.1649 121	-0.08563 0.3504 121	-0.26325 0.0043 116	0.03693 0.7017 110	0.02329 0.8660 55	-0.09873 0.3004 112	0.03078 0.7429 116
TNO_T	0.17429 0.0613 116	0.21112 0.0434 92	0.35677 0.0001 118	0.92095 0.0001 130	1.00000 0.0 130	0.17877 0.0498 121	-0.07679 0.4025 121	-0.16436 0.0779 116	-0.04252 0.6592 110	-0.00573 0.9669 55	-0.03435 0.7192 112	-0.00872 0.9260 116
AGE	0.22605 0.0181 109	0.02976 0.7856 86	0.25053 0.0083 110	0.12707 0.1649 121	0.17877 0.0498 121	1.00000 0.0 121	0.36121 0.0001 121	-0.06140 0.5279 108	-0.08527 0.3941 102	-0.29324 0.0331 53	-0.09813 0.3217 104	-0.05586 0.5658 108
KESALS	0.09334 0.3344 109	0.11111 0.3085 86	-0.00408 0.9663 110	-0.08563 0.3504 121	-0.07679 0.4025 121	0.36121 0.0001 121	1.00000 0.0 121	0.07031 0.4696 108	0.05336 0.5942 102	-0.04547 0.7465 53	-0.10881 0.2716 104	-0.01140 0.9068 108
SURTH	0.03816 0.9125 102	-0.28057 0.0326 83	-0.09800 0.7273 104	-0.26325 0.7017 116	-0.16436 0.6592 116	-0.06140 0.3941 108	0.07031 0.5942 108	1.00000 0.0583 116	-0.18109 0.0 110	-0.17461 0.8356 55	0.23533 0.2683 112	-0.42338 0.0689 116
TBTHK	-0.01136 0.9125 96	0.233771 0.0326 81	0.03568 0.7273 98	0.03693 0.7017 110	-0.04252 0.6592 110	-0.08527 0.3941 102	0.05336 0.5942 102	-0.18109 0.0583 110	1.00000 0.0 110	0.02920 0.8356 53	-0.10850 0.2683 106	0.17410 0.0689 110
GSBTH	-0.11322 0.4590 45	-0.26375 0.1147 37	-0.01116 0.9400 48	0.02329 0.8660 55	-0.00573 0.9669 55	-0.29324 0.0331 53	-0.04547 0.7465 53	-0.17461 0.2023 55	0.02920 0.8356 53	1.00000 0.0 55	-0.12253 0.3774 54	0.02114 0.8782 55

Table 3.4. Correlation Analysis for Significant Variables in the GPS-1 Data Set (SAS Format)

Pearson Correlation Coefficients/Prob > |R| under Ho: Rho=0/Number of Observations

	MEAN6	I_IRI	B_IRI	TCRK_T	TNO_T	AGE	KESALS	SURTH	TBTHK	GSBTH	V140	A_CON
V140	0.06128 0.5489 98	-0.13710 0.2223 81	0.01099 0.9136 100	-0.09873 0.3004 112	-0.03435 0.7192 112	-0.09813 0.3217 104	-0.10881 0.2716 104	0.23533 0.0125 112	0.10850 0.2683 106	-0.12253 0.3774 54	1.00000 0.0 112	-0.21740 0.0213 112
A_CON	0.08701 0.3845 102	0.25130 0.0219 83	0.02224 0.8227 104	0.03078 0.7429 116	-0.00872 0.9260 116	-0.05586 0.5658 108	-0.01140 0.9068 108	-0.42338 0.0001 116	0.17410 0.0689 110	0.02114 0.8782 55	-0.21740 0.0213 112	1.00000 0.0 116
AV	-0.16933 0.0991 96	0.03177 0.7825 78	0.06979 0.4947 98	0.01529 0.8740 110	0.052912 0.5830 110	0.01906 0.8492 102	0.00973 0.9226 102	0.07332 0.4465 110	-0.15098 0.1260 104	-0.10615 0.4493 53	0.01133 0.9082 106	-0.25103 0.0082 110
%4	0.17830 0.0774 99	0.22520 0.0432 81	0.03007 0.7653 101	0.03428 0.7185 113	-0.02549 0.7887 113	-0.05784 0.5578 105	-0.19580 0.0453 105	-0.31363 0.0007 113	0.06097 0.5327 107	0.04507 0.7462 54	-0.07714 0.4231 110	0.29984 0.0013 113
A_CONB	0.42155 0.0814 18	0.59670 0.0243 14	-0.66983 0.0024 18	0.18065 0.4333 21	0.16981 0.4618 21	0.22439 0.3707 18	0.06512 0.7974 18	-0.29811 0.1893 21	0.37311 0.0957 21	0.35803 0.2088 14	-0.02080 0.9287 21	0.53669 0.0121 21
AVB	-0.00231 0.9927 18	0.35673 0.2106 14	-0.49912 0.0350 18	-0.26610 0.2436 21	-0.29096 0.2007 21	0.26239 0.2928 18	-0.13056 0.6056 18	0.00183 0.9937 21	-0.00364 0.9875 21	0.08712 0.7671 14	0.07907 0.7333 21	0.18648 0.4183 21
%200	0.11273 0.2691 98	-0.27681 0.0135 79	0.09771 0.3335 100	0.12614 0.1871 111	0.11628 0.2242 111	0.03756 0.7050 104	-0.19273 0.0500 104	0.11651 0.2233 111	-0.06686 0.4980 105	-0.13258 0.3537 51	-0.04556 0.6412 107	-0.15958 0.0943 111
MOIST	0.17192 0.0888 99	-0.07498 0.5059 81	0.05030 0.6156 102	0.07404 0.4357 113	0.06416 0.4996 113	-0.01689 0.8642 105	-0.12279 0.2121 105	0.06392 0.5012 113	0.17123 0.0778 107	-0.25384 0.0694 52	-0.03355 0.7291 109	-0.01594 0.8669 113
TPREC	-0.12903 0.1771 111	-0.28048 0.0093 85	-0.23028 0.0141 113	-0.15133 0.0961 122	-0.10106 0.2680 122	-0.07594 0.4240 113	-0.22276 0.0177 113	0.22048 0.0212 109	-0.31326 0.0012 104	-0.20486 0.1535 50	0.44068 0.0001 105	-0.24470 0.0103 109
AVG90	-0.05411 0.5727 111	0.15265 0.1631 85	-0.05650 0.5523 113	-0.00419 0.9634 122	0.03955 0.6654 122	0.02079 0.8270 113	0.15595 0.0991 113	-0.08800 0.3628 109	-0.06798 0.4929 104	-0.03694 0.7990 50	0.03682 0.7092 105	0.00314 0.9741 109

Table 3.4. Correlation Analysis for Significant Variables in the GPS-1 Data Set (SAS Format)

Pearson Correlation Coefficients/Prob > |R| under Ho: Rho=0/Number of Observations

	MEAN6	I_IRI	B_IRI	TCRK_T	TNO_T	AGE	KESALS	SURTH	TBTHK	GSBTH	V140	A_CON
AVG32	0.19702	0.09704	0.20964	0.16848	0.13588	-0.09134	-0.19784	-0.05273	0.18403	0.18965	-0.29545	0.17069
	0.0382	0.3769	0.0258	0.0636	0.1356	0.3360	0.0357	0.5861	0.0615	0.1871	0.0022	0.0760
	111	85	113	122	122	113	113	109	104	50	105	109
FTIN	0.21590	0.02919	0.22772	0.17826	0.09437	-0.02964	-0.17087	-0.11290	0.09926	0.29968	-0.34736	0.16196
	0.0229	0.7909	0.0153	0.0495	0.3012	0.7553	0.0704	0.2425	0.3161	0.0345	0.0003	0.0925
	111	85	113	122	122	113	113	109	104	50	105	109
FRZTH	0.14298	0.12990	0.15539	0.12130	0.13003	-0.10725	-0.16889	-0.02292	0.22441	0.04970	-0.20472	0.15729
	0.1344	0.2361	0.1003	0.1832	0.1534	0.2582	0.0737	0.8130	0.0220	0.7318	0.0362	0.1024
	111	85	113	122	122	113	113	109	104	50	105	109
%CEM	-0.00525	0.38080	-0.00631	0.24536	0.22993	-0.30178	-0.29866	0.12796	0.16777	0.25694	0.12194	-0.15407
	0.9697	0.0090	0.9625	0.0588	0.0772	0.0225	0.0240	0.3565	0.2298	0.3034	0.3892	0.2660
	55	46	58	60	60	57	57	54	53	18	52	54

Table 3.4. Correlation Analysis for Significant Variables in the GPS-1 Data Set (SAS Format)

Pearson Correlation Coefficients/Prob > |R| under Ho: Rho=0/Number of Observations

	AV	%4	A_CONB	AVB	%200	MOIST	TPREC	AVG90	AVG32	FTIN	FRZTH	%CEM
MEAN6	-0.16933 0.0991 96	0.17830 0.0774 99	0.42155 0.0814 18	-0.00231 0.9927 18	0.11273 0.2691 98	0.17192 0.0888 99	-0.12903 0.1771 111	-0.05411 0.5727 111	0.19702 0.0382 111	0.21590 0.0229 111	0.14298 0.1344 111	-0.00525 0.9697 55
I_IRI	0.03177 0.7825 78	0.22520 0.0432 81	0.59670 0.0243 14	0.36573 0.2106 14	-0.27681 0.0135 79	-0.07498 0.5059 81	-0.28048 0.0093 85	0.15265 0.1631 85	0.09704 0.3769 85	0.02919 0.7909 85	0.12990 0.2361 85	0.38080 0.0090 46
B_IRI	0.06979 0.4947 98	0.03007 0.7653 101	-0.66983 0.0024 18	-0.49912 0.0350 18	0.09771 0.3335 100	0.05030 0.6156 102	-0.23028 0.0141 113	-0.05650 0.5523 113	0.20964 0.0258 113	0.22772 0.0153 113	0.15539 0.1003 113	-0.00631 0.9625 58
TCRK_T	0.01529 0.8740 110	0.03428 0.7185 113	0.18065 0.4333 21	-0.26610 0.2436 21	0.12614 0.1871 111	0.07404 0.4357 113	-0.15133 0.0961 122	-0.00419 0.9634 122	0.16848 0.0636 122	0.17826 0.0495 122	0.12130 0.1832 122	0.24536 0.0588 60
TNO_T	0.05291 0.5830 110	-0.02549 0.7887 113	0.16981 0.4618 21	-0.29096 0.2007 21	0.11628 0.2242 111	0.06416 0.4996 113	-0.10106 0.2680 122	0.03955 0.6654 122	0.13588 0.1356 122	0.09437 0.3012 122	0.13003 0.1534 122	0.22993 0.0772 60
AGE	0.01906 0.8492 102	-0.05784 0.5578 105	0.22439 0.3707 18	0.26239 0.2928 18	0.03756 0.7050 104	-0.01689 0.8642 105	-0.07594 0.4240 113	0.02079 0.8270 113	-0.09134 0.3360 113	-0.02964 0.7553 113	-0.10725 0.2582 113	-0.30178 0.0225 57
KESALS	0.00973 0.9226 102	-0.19580 0.0453 105	0.06512 0.7974 18	-0.13056 0.6056 18	-0.19273 0.0500 104	-0.12279 0.2121 105	-0.22276 0.0177 113	0.15595 0.0991 113	-0.19784 0.0357 113	-0.17087 0.0704 113	-0.16889 0.0737 113	-0.29866 0.0240 57
SURTH	0.07332 0.4465 110	-0.31363 0.0007 113	-0.29811 0.1893 21	0.00183 0.9937 21	0.11651 0.2233 111	0.06392 0.5012 113	0.22048 0.0212 109	-0.08800 0.3628 109	-0.05273 0.5861 109	-0.11290 0.2425 109	-0.02292 0.8130 109	0.12796 0.3565 54
TBTHK	-0.15098 0.1260 104	0.06097 0.5327 107	0.37311 0.0957 21	-0.00364 0.9875 21	-0.06686 0.4980 105	0.17123 0.0778 107	-0.31326 0.0012 104	-0.06798 0.4929 104	0.18403 0.0615 104	0.09926 0.3161 104	0.22441 0.0220 104	0.16777 0.2298 53
GBTHK	-0.10615 0.4493 53	0.04507 0.7462 54	0.35803 0.2088 14	0.08712 0.7671 14	-0.13258 0.3537 51	-0.25384 0.0694 52	-0.20486 0.1535 50	-0.03694 0.7990 50	0.18965 0.1871 50	0.29968 0.0345 50	0.04970 0.7318 50	0.25694 0.3034 18

Table 3.4. Correlation Analysis for Significant Variables in the GPS-1 Data Set (SAS Format)

Pearson Correlation Coefficients/Prob > |R| under Ho: Rho=0/Number of Observations

	AV	%4	A_CONB	AVB	%200	MOIST	TPREC	AVG90	AVG32	FTIN	FRZTH	%CEM
V140	0.011333 0.9082 106	-0.07714 0.4231 110	-0.02080 0.9287 21	0.07907 0.7333 21	-0.04556 0.6412 107	-0.03355 0.7291 109	0.44068 0.0001 105	0.03682 0.7092 105	-0.29545 0.0022 105	-0.34736 0.0003 105	-0.20472 0.0362 105	0.12194 0.3892 52
A_CON	-0.25103 0.0082 110	0.29984 0.0013 113	0.53669 0.0121 21	0.18648 0.4183 21	-0.15958 0.0943 111	-0.01594 0.8669 113	-0.24470 0.0103 109	0.00314 0.9741 109	0.17069 0.0760 109	0.16196 0.0925 109	0.15729 0.1024 109	-0.15407 0.2660 54
AV	1.00000 0.0 110	0.10518 0.2764 109	-0.41856 0.0663 20	-0.10634 0.6554 20	-0.06110 0.5358 105	0.11043 0.2575 107	0.21029 0.0330 103	0.10705 0.2818 103	-0.31564 0.0012 103	-0.24035 0.0145 103	-0.29330 0.0026 103	-0.18453 0.1995 50
%4	0.10518 0.2764 109	1.00000 0.0 113	0.34059 0.1308 21	0.34994 0.1199 21	-0.03681 0.7053 108	0.06496 0.5002 110	0.10767 0.2719 106	0.13538 0.1664 106	-0.07580 0.4400 106	0.01232 0.9003 106	-0.11597 0.2365 106	0.01045 0.9414 52
ACONB	-0.41856 0.0663 20	0.34059 0.1308 21	1.00000 0.0 21	0.46777 0.0325 21	-0.20142 0.4083 19	-0.19882 0.4007 20	0.19760 0.3906 21	0.48121 0.0272 21	-0.37649 0.0925 21	-0.39430 0.0769 21	-0.36915 0.0996 21	1.00000 2
AVB	-0.10634 0.6554 20	0.34994 0.1199 21	0.46777 0.0325 21	1.00000 0.0 21	-0.23234 0.3385 19	-0.14779 0.5341 20	0.57678 0.0062 21	0.05224 0.8221 21	-0.26301 0.2494 21	-0.33896 0.1328 21	-0.24351 0.2875 21	-1.00000 2
%200	-0.06110 0.5358 105	-0.03681 0.7053 108	-0.20142 0.4083 19	-0.23234 0.3385 19	1.00000 0.0 111	0.65620 0.0001 111	0.13350 0.1767 104	-0.13061 0.1863 104	0.08706 0.3795 104	0.02527 0.7990 104	0.07429 0.4536 104	0.15263 0.2705 54
MOIST	0.11043 0.2575 107	0.06496 0.5002 110	-0.19882 0.4007 20	-0.14779 0.5341 20	0.65620 0.0001 111	1.00000 0.0 113	0.13791 0.1586 106	-0.09894 0.3129 106	0.02033 0.8361 106	-0.07416 0.4499 106	0.08426 0.3905 106	0.11381 0.4126 54
TPREC	0.21029 0.0330 103	0.10767 0.2719 106	0.19760 0.3906 21	0.57678 0.0062 21	0.13350 0.1767 104	0.13791 0.1586 106	1.00000 0.0 122	-0.05885 0.5196 122	-0.44604 0.0001 122	-0.37385 0.0001 122	-0.42971 0.0001 122	0.23312 0.0730 60
AVG90	0.10705 0.2818 103	0.13538 0.1664 106	0.48121 0.0272 21	0.05224 0.8221 21	-0.13061 0.1863 104	-0.09894 0.3129 106	-0.05885 0.5196 122	1.00000 0.0 122	-0.59569 0.0001 122	-0.54919 0.0001 122	-0.48896 0.0001 122	-0.01725 0.8959 60

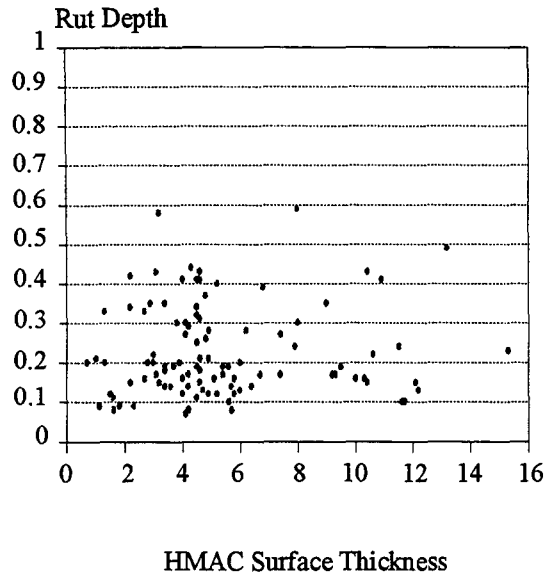
Table 3.4. Correlation Analysis for Significant Variables in the GPS-1 Data Set (SAS Format)

Pearson Correlation Coefficients/Prob > |R| under Ho: Rho=0/Number of Observations

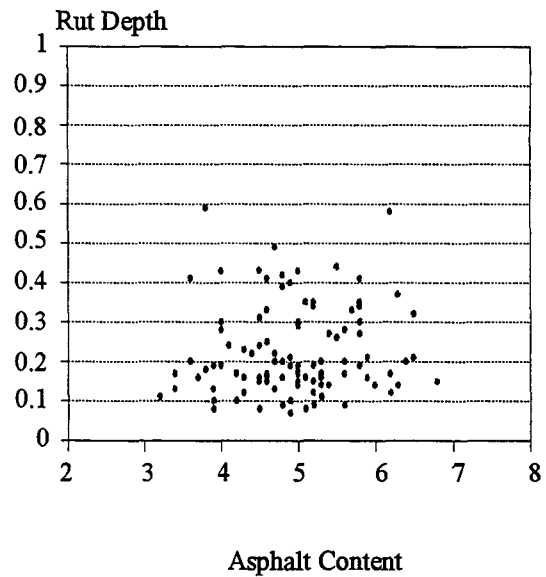
	AV	%4	A_CONB	AVB	%200	MOIST	TPREC	AVG90	AVG32	FTIN	FRZTH	%CEM
AVG32	-0.31564 0.0012 103	-0.07580 0.4400 106	-0.37649 0.0925 21	-0.26301 0.2494 21	0.08706 0.3795 104	0.02033 0.8361 106	-0.44604 0.0001 122	-0.59569 0.0001 122	1.00000 0.0 122	0.81919 0.0001 122	0.91644 0.0001 122	0.20840 0.1101 60
FTIN	-0.24035 0.0145 103	0.01232 0.9003 106	-0.39430 0.0769 21	-0.33896 0.1328 21	0.02527 0.7990 104	-0.07416 0.4499 106	-0.37385 0.0001 122	-0.54919 0.0001 122	0.81919 0.0001 122	1.00000 0.0 122	0.53634 0.0001 122	0.21421 0.1003 60
FRZTH	-0.29330 0.0026 103	-0.11597 0.2365 106	-0.36915 0.0996 21	-0.24351 0.2875 21	0.07429 0.4536 104	0.08426 0.3905 106	-0.42971 0.0001 122	-0.48896 0.0001 122	0.91644 0.0001 122	0.53634 0.0001 122	1.00000 0.0 122	0.16921 0.1962 60
%CEM	-0.18453 0.1995 50	0.01045 0.9414 52	1.00000 2	-1.00000 2	0.15263 0.2705 54	0.11381 0.4126 54	0.23312 0.0730 60	-0.01725 0.8959 60	0.20840 0.1101 60	0.21421 0.1003 60	0.16921 0.1962 60	1.00000 0.0 60

**Table 3.5. Frequency Table by Environmental Region for the GPS-2 Data Set
(SAS Format)**

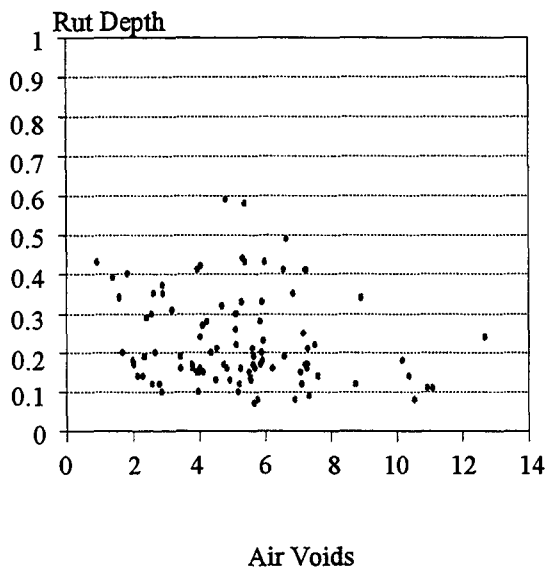
Frequency Percent Row Percent Column Percent	Freeze	No-Freeze	Total
Dry	21 16.15 48.84 42.00	22 16.92 51.16 27.50	43 33.08
Wet	29 22.31 33.33 58.00	58 44.62 66.67 72.50	87 66.92
Total	50 38.46	80 61.54	130 100.00



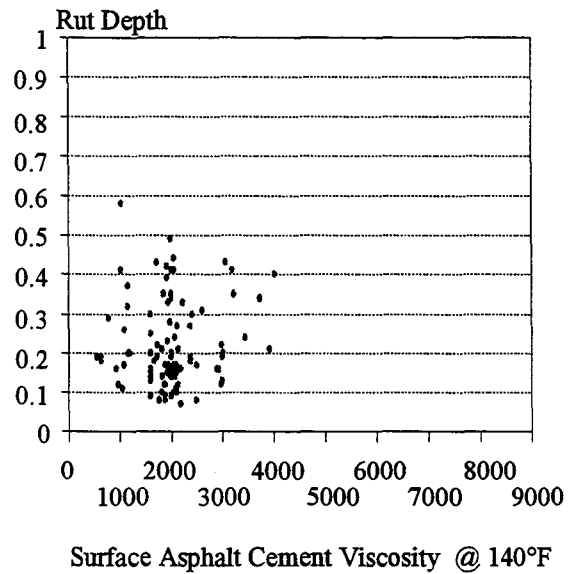
a. Rut Depth vs. HMAC Surface Thick.



b. Rut Depth vs. Asphalt Content

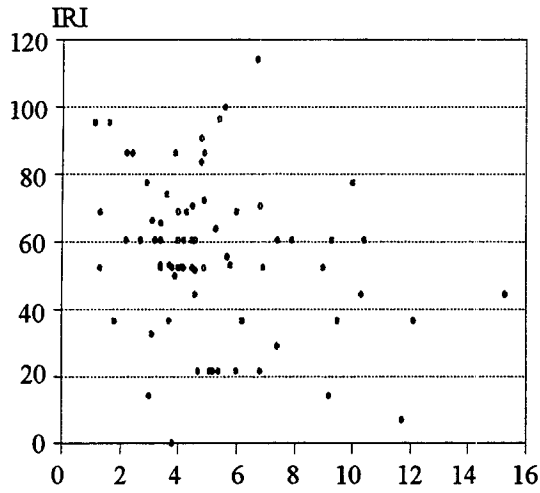


c. Rut Depth vs. Air Voids



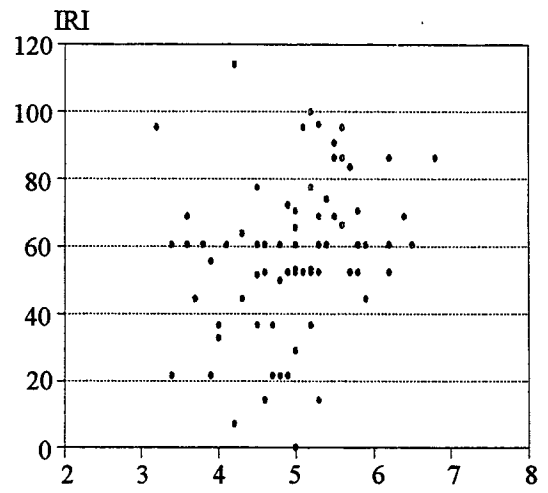
d. Rut Depth vs. Visc. @ 140°F

Figure 3.2. Rut Depth Scatter Plots for GPS-2 Test Sections



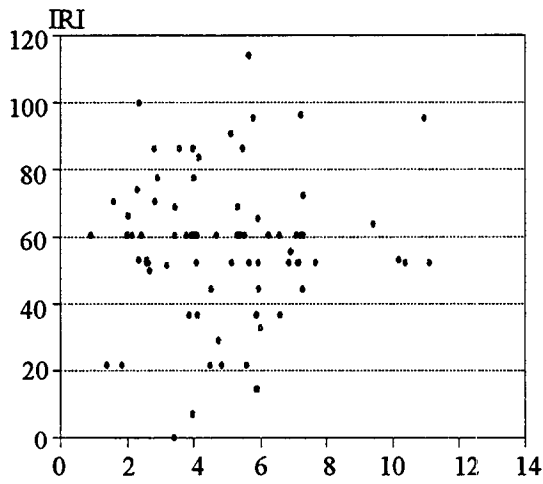
HMAC Surface Thickness

a. IRI vs. HMAC Surface Thick.



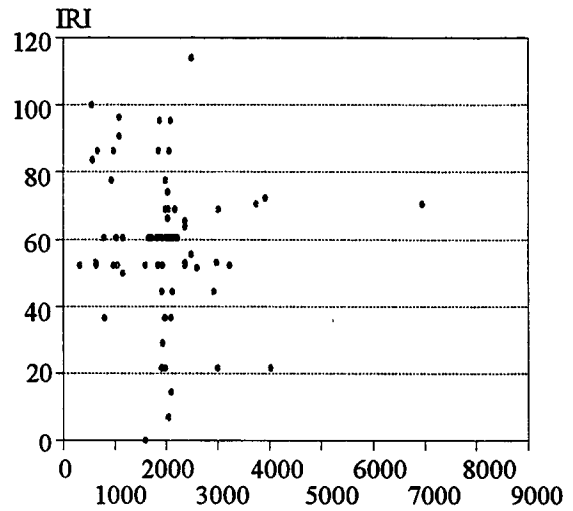
Asphalt Content

b. IRI vs. Asphalt Content



Air Voids

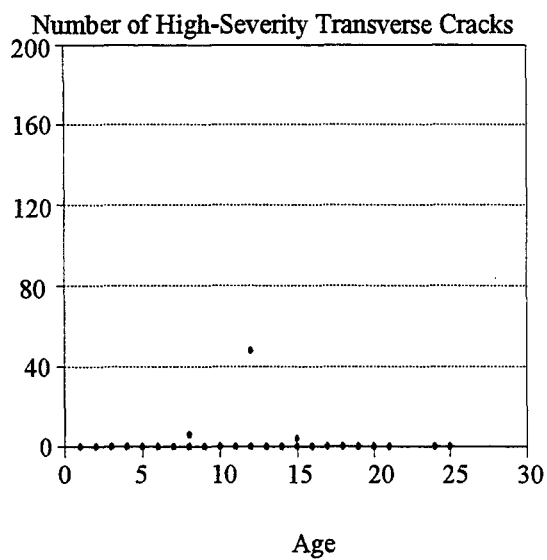
c. IRI vs. Air Voids



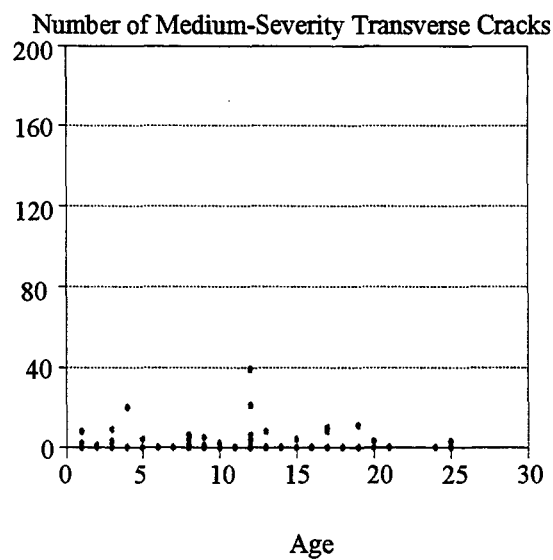
Surface Asphalt Cement Viscosity @ 140°F

d. IRI vs. Visc. @ 140°F

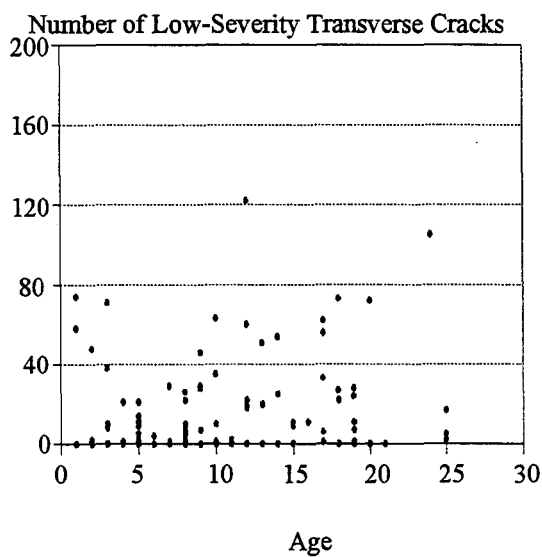
Figure 3.3. IRI Scatter Plots for GPS-2 Test Sections



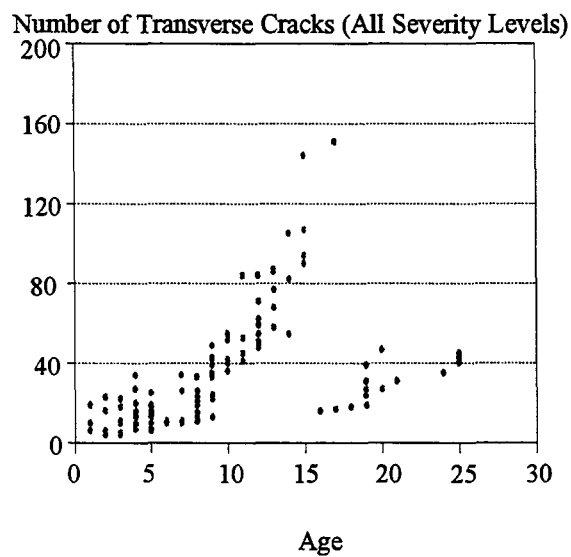
a. High-Severity



b. Medium-Severity

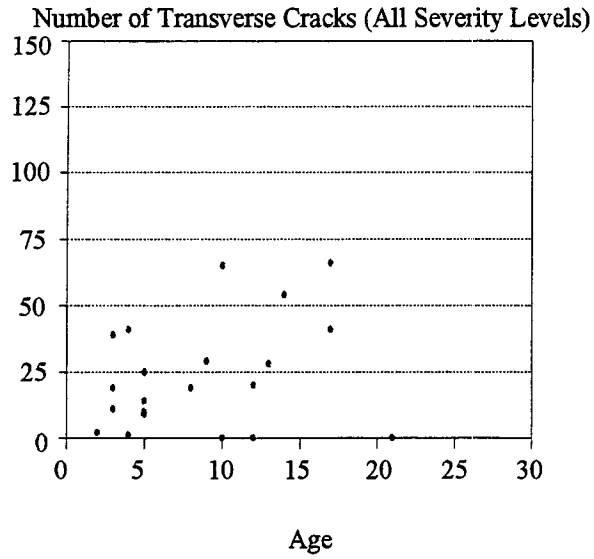


c. Low-Severity

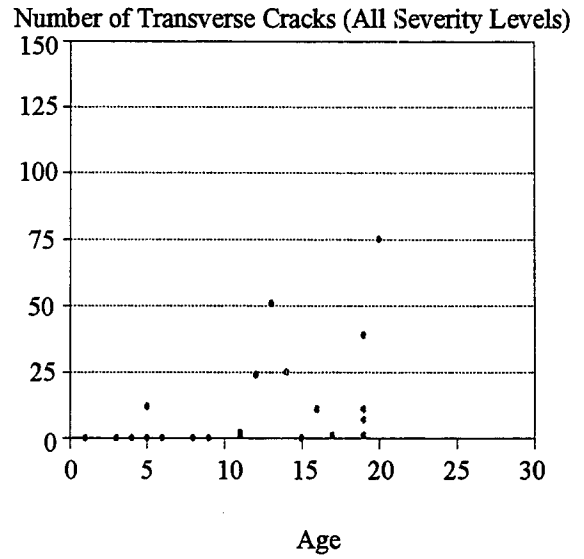


d. All Severity Levels

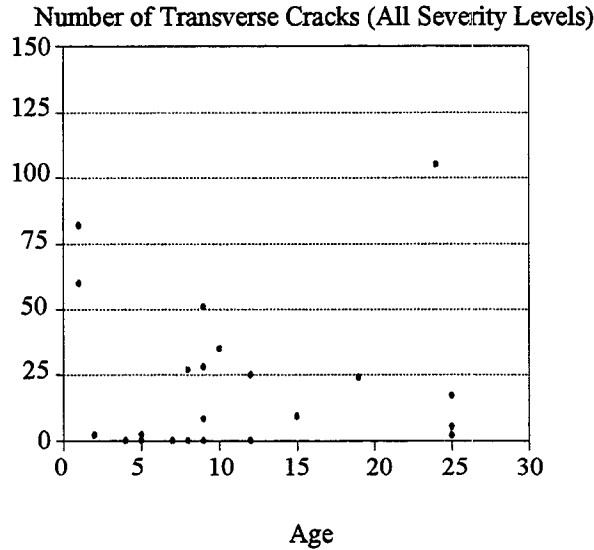
Figure 3.4. Number of Transverse Cracks vs. Age for GPS-2 Test Sections



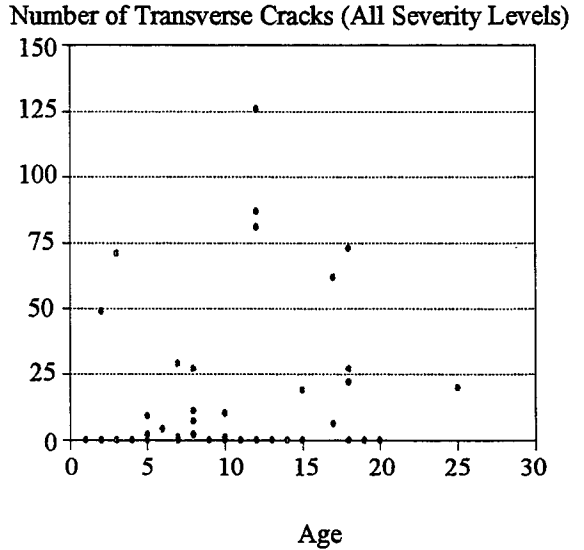
a. Dry-Freeze



b. Dry-No Freeze

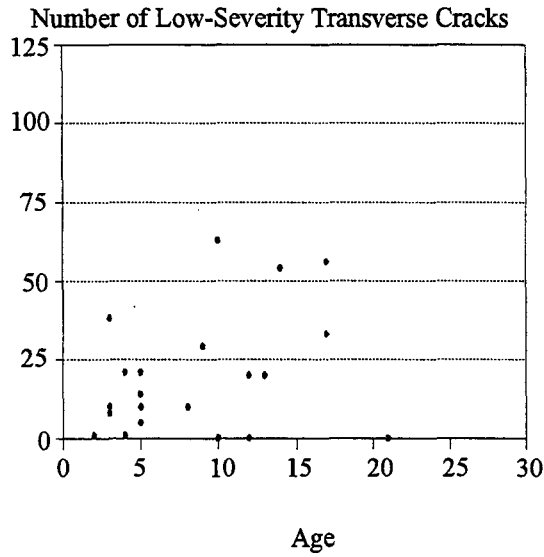


c. Wet-Freeze

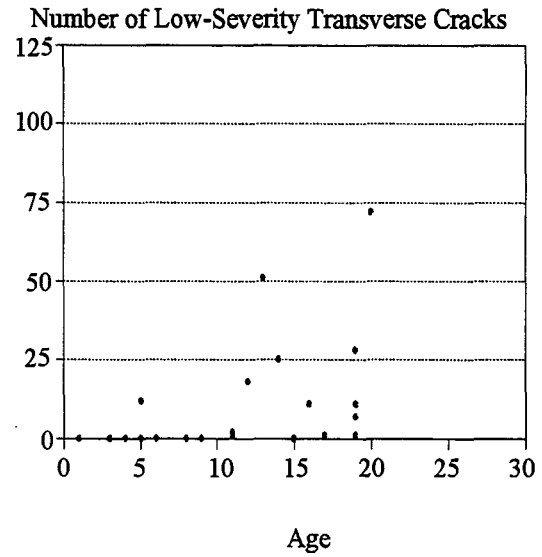


d. Wet-No Freeze

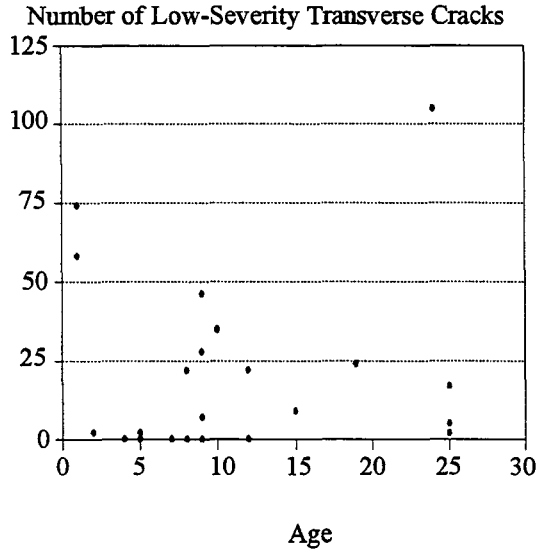
Figure 3.5. Number of Transverse Cracks (All Severity Levels) vs. Age for GPS-2 Test Sections



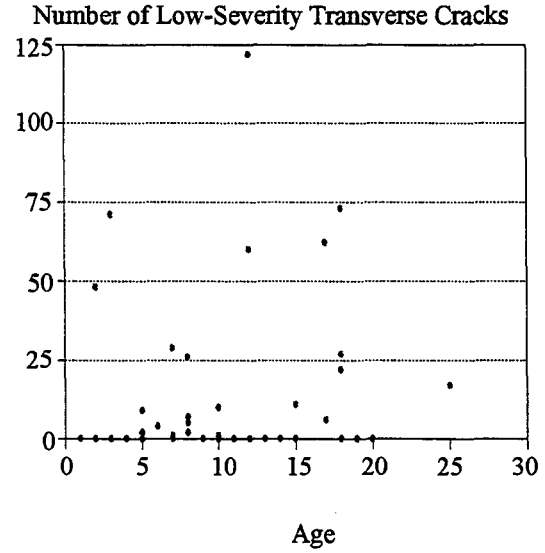
a. Dry-Freeze



b. Dry-No Freeze

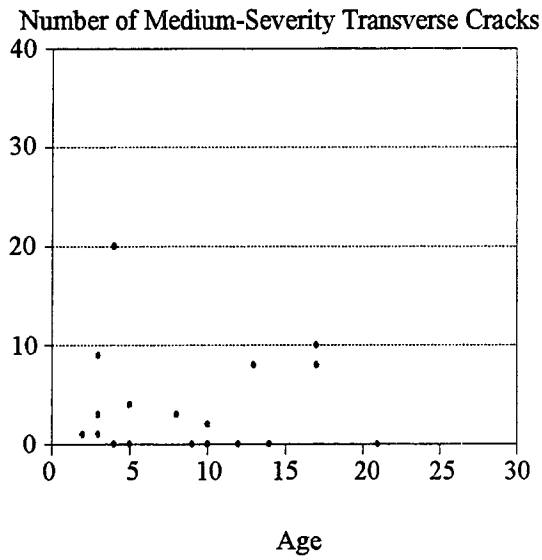


c. Wet-Freeze

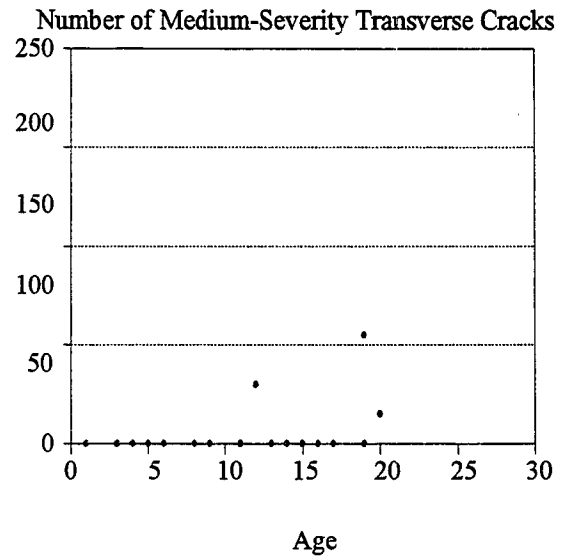


d. Wet-No Freeze

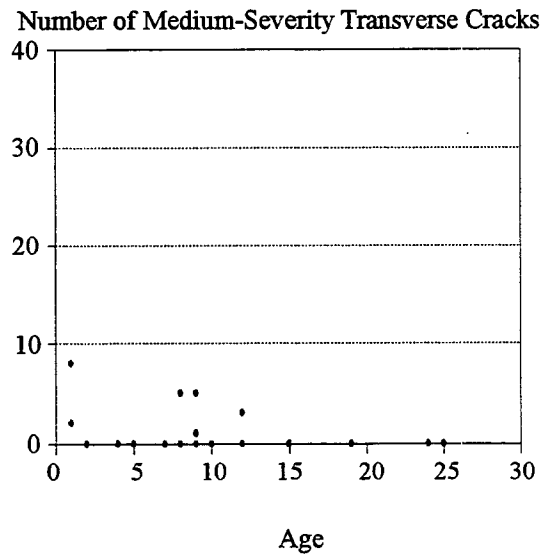
Figure 3.6. Number of Low-Severity Transverse Cracks vs. Age for GPS-2 Test Sections



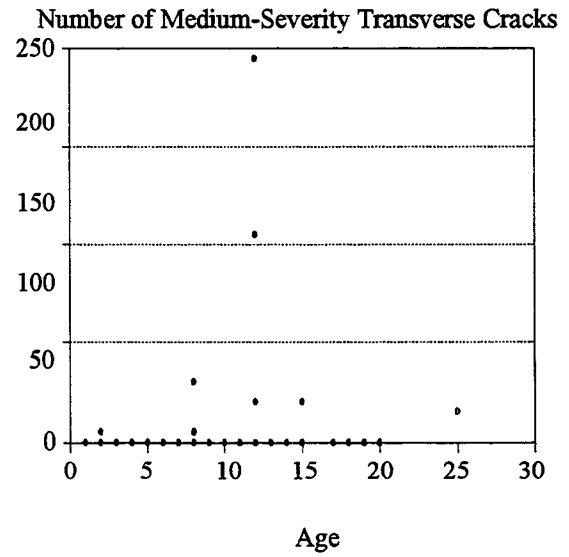
a. Dry-Freeze



b. Dry-No Freeze

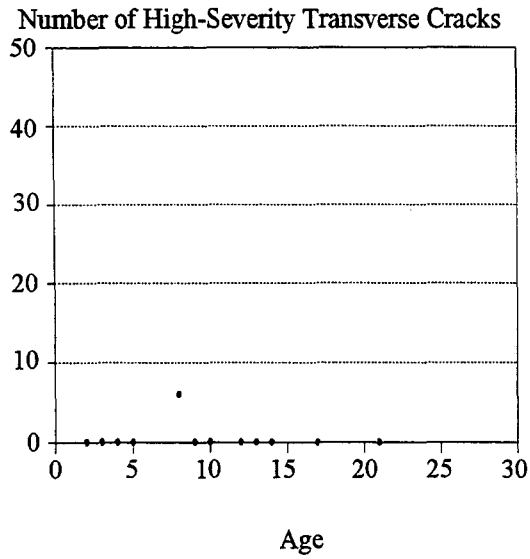


c. Wet-Freeze

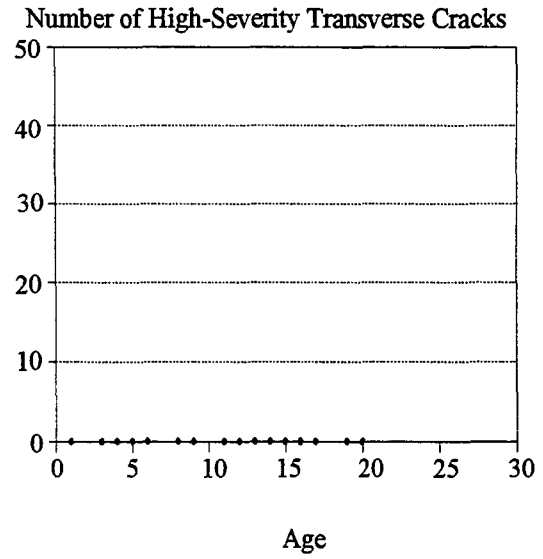


d. Wet-No Freeze

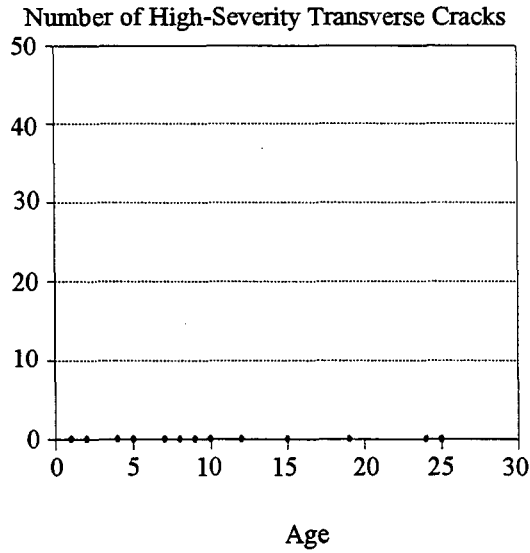
Figure 3.7. Number of Medium-Severity Transverse Cracks vs. Age for GPS-2 Test Sections



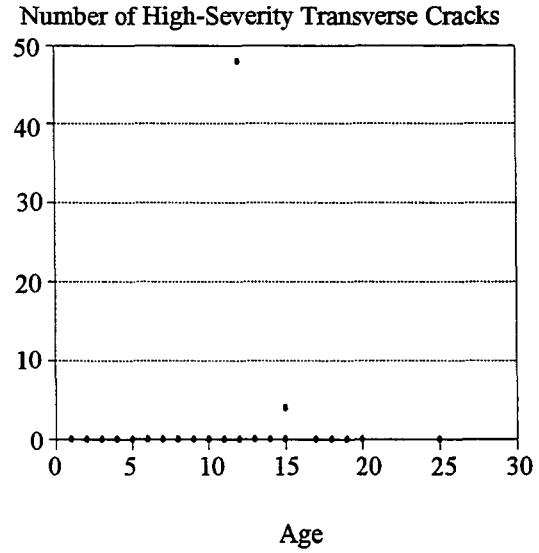
a. Dry-Freeze



b. Dry-No Freeze

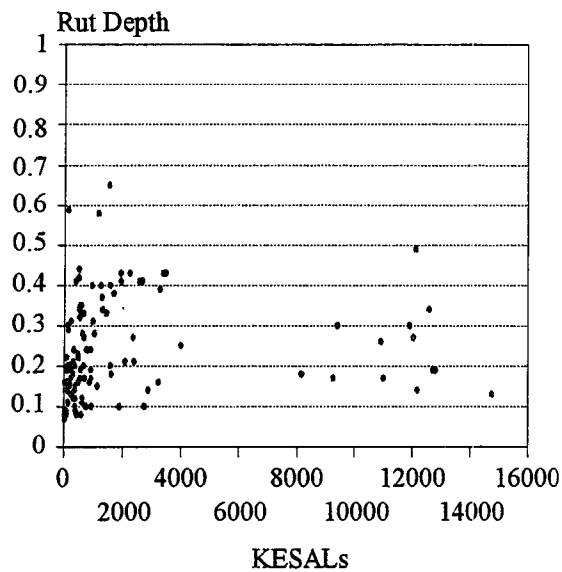


c. Wet-Freeze

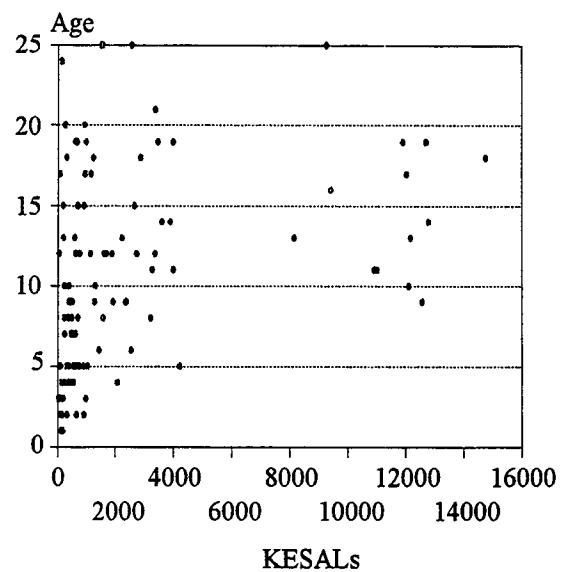


d. Wet-No Freeze

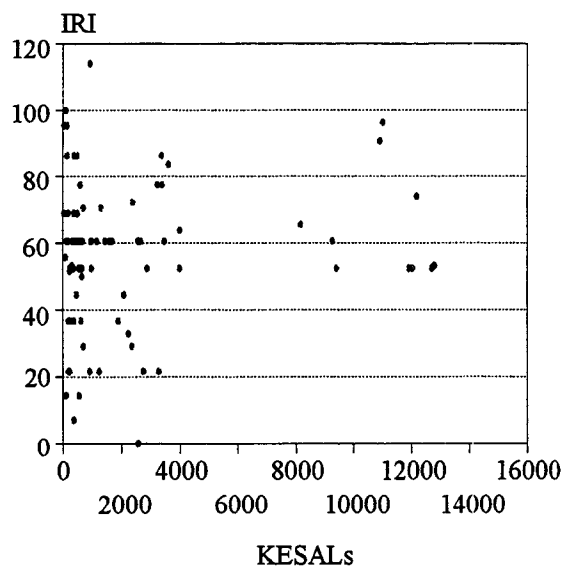
Figure 3.8. Number of High-Severity Transverse Cracks vs. Age for GPS-2 Test Sections



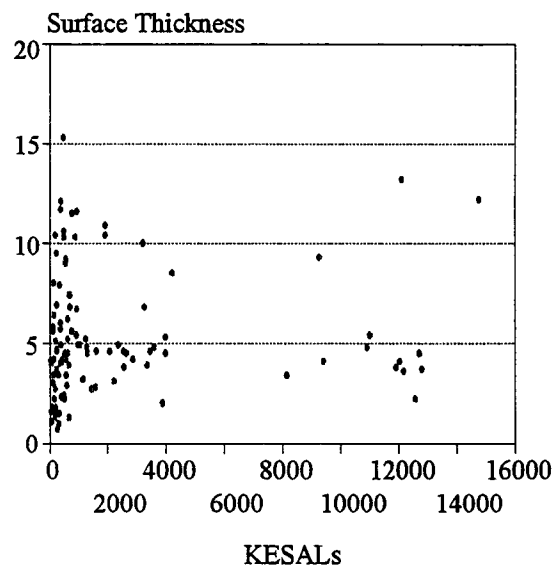
a. Rut Depth vs. KESALs



b. Age vs. KESALs

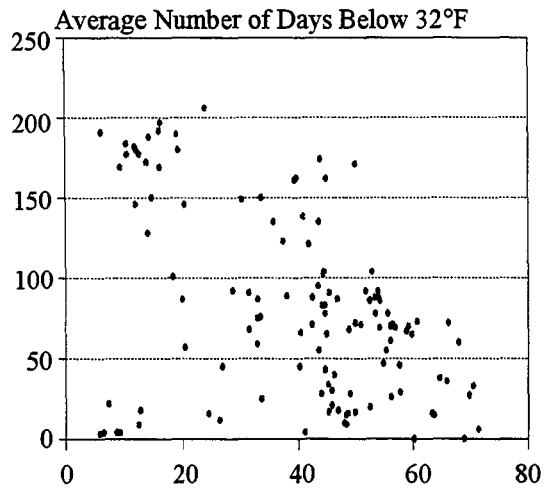


c. IRI vs. KESALs



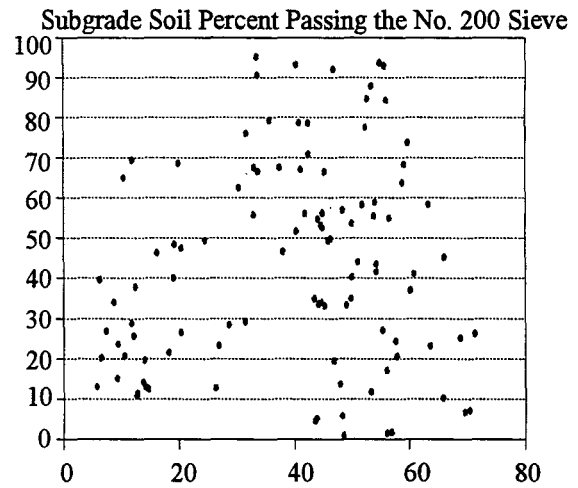
d. Surface Thick. vs. KESALs

Figure 3.9. KESALs Scatter Plots for GPS-2 Test Sections



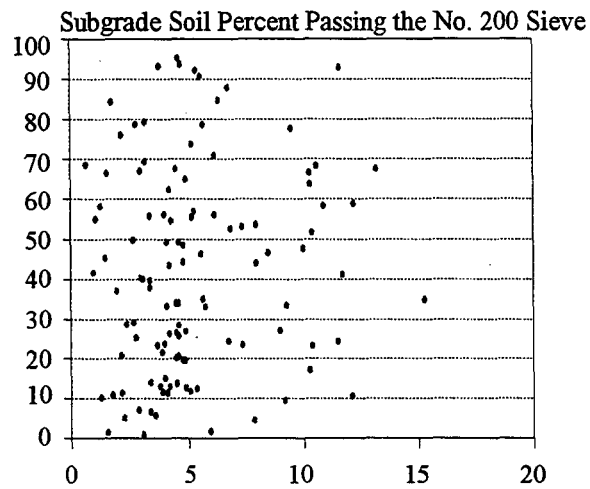
Average Annual Total Precipitation

a. Days <32°F vs. Ann. Prec.



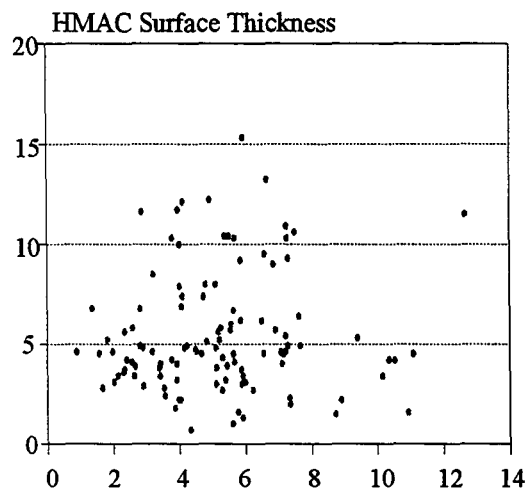
Average Annual Total Precipitation

b. Subgrade <#200 vs. Ann. Prec.



HMAC Surface Thickness

c. Subgrade <#200 vs. HMAC Thick.



HMAC Air Voids

d. HMAC Thick. vs. HMAC Air Voids

Figure 3.10. Scatter Plots for GPS-2 Test Sections

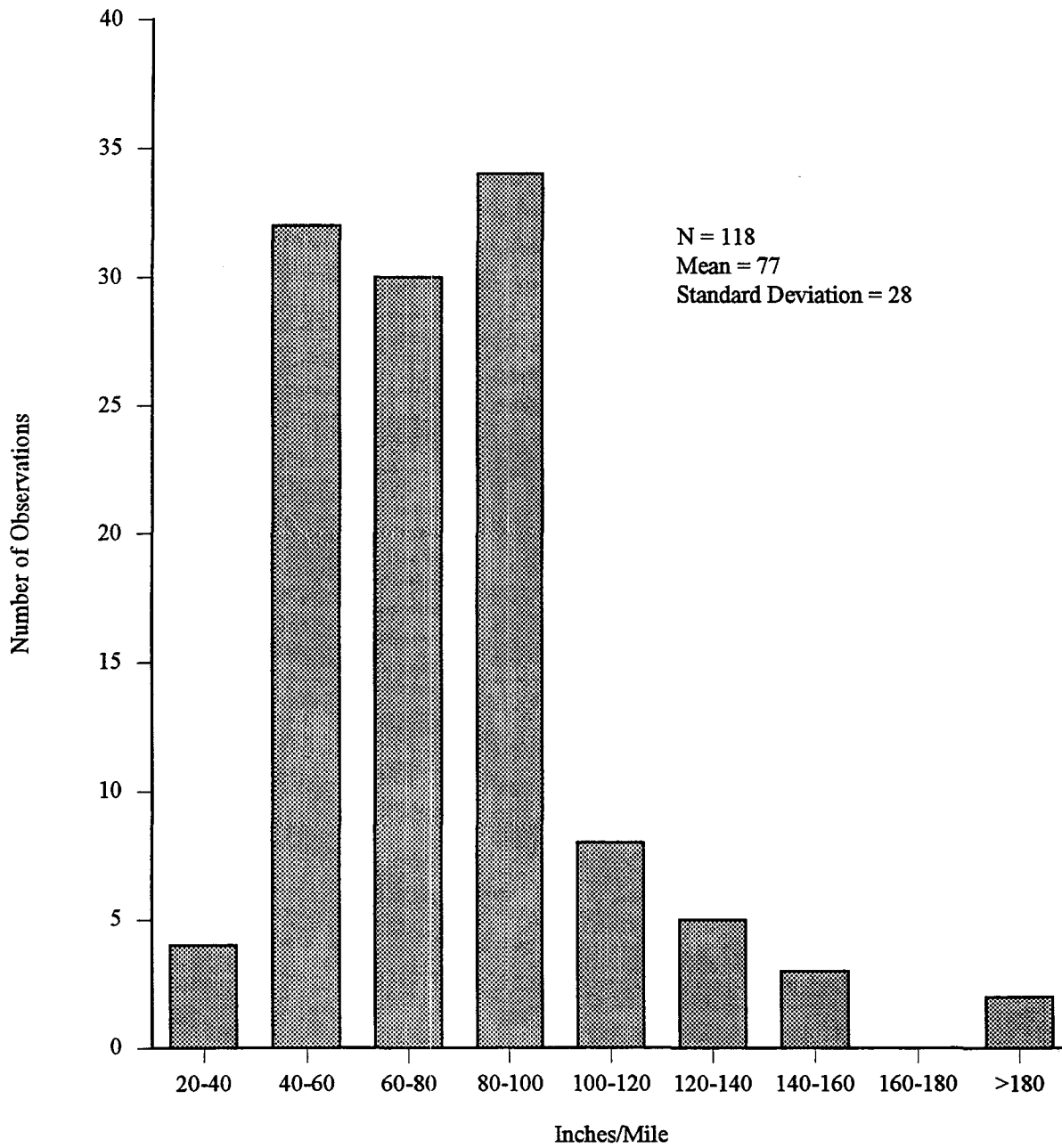


Figure 3.11. Distribution of Measured International Roughness Index for GPS-2 Test Sections

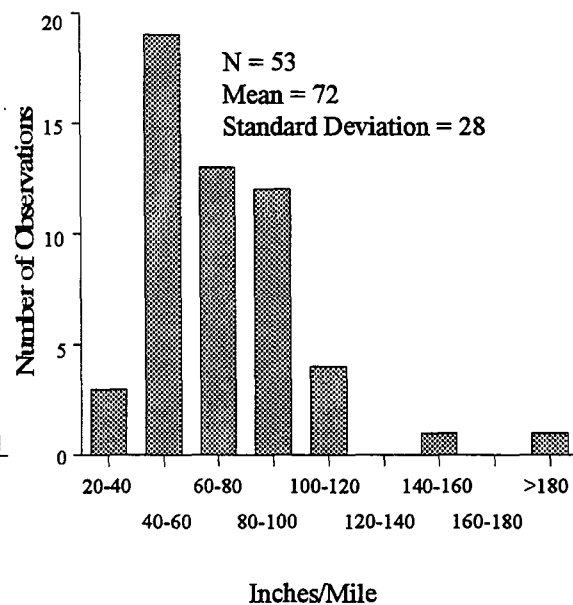
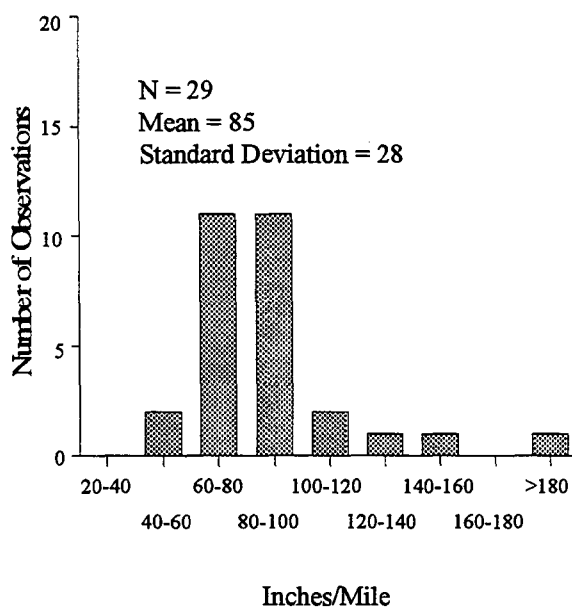
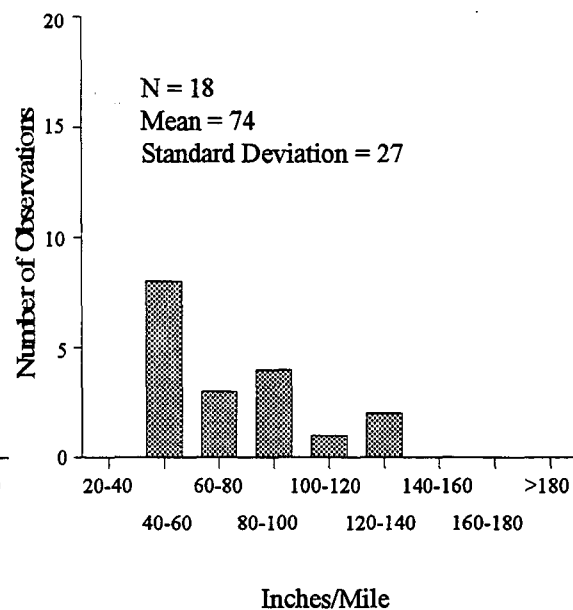
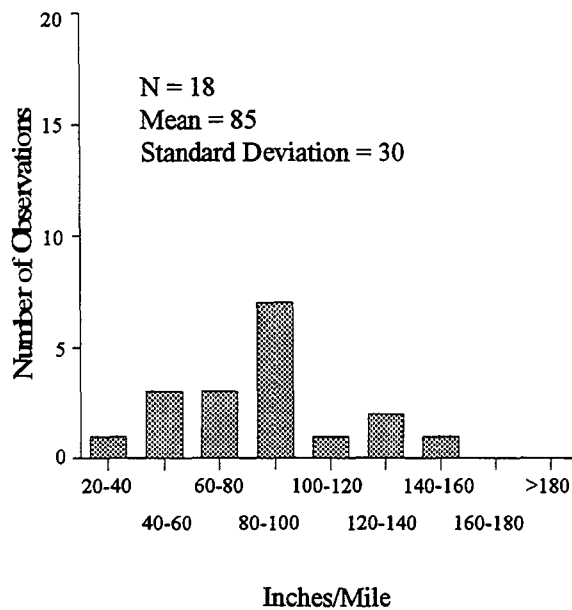


Figure 3.12. Distributions of Measured International Roughness Index (IRI) by Environmental Regions for GPS-2 Test Sections

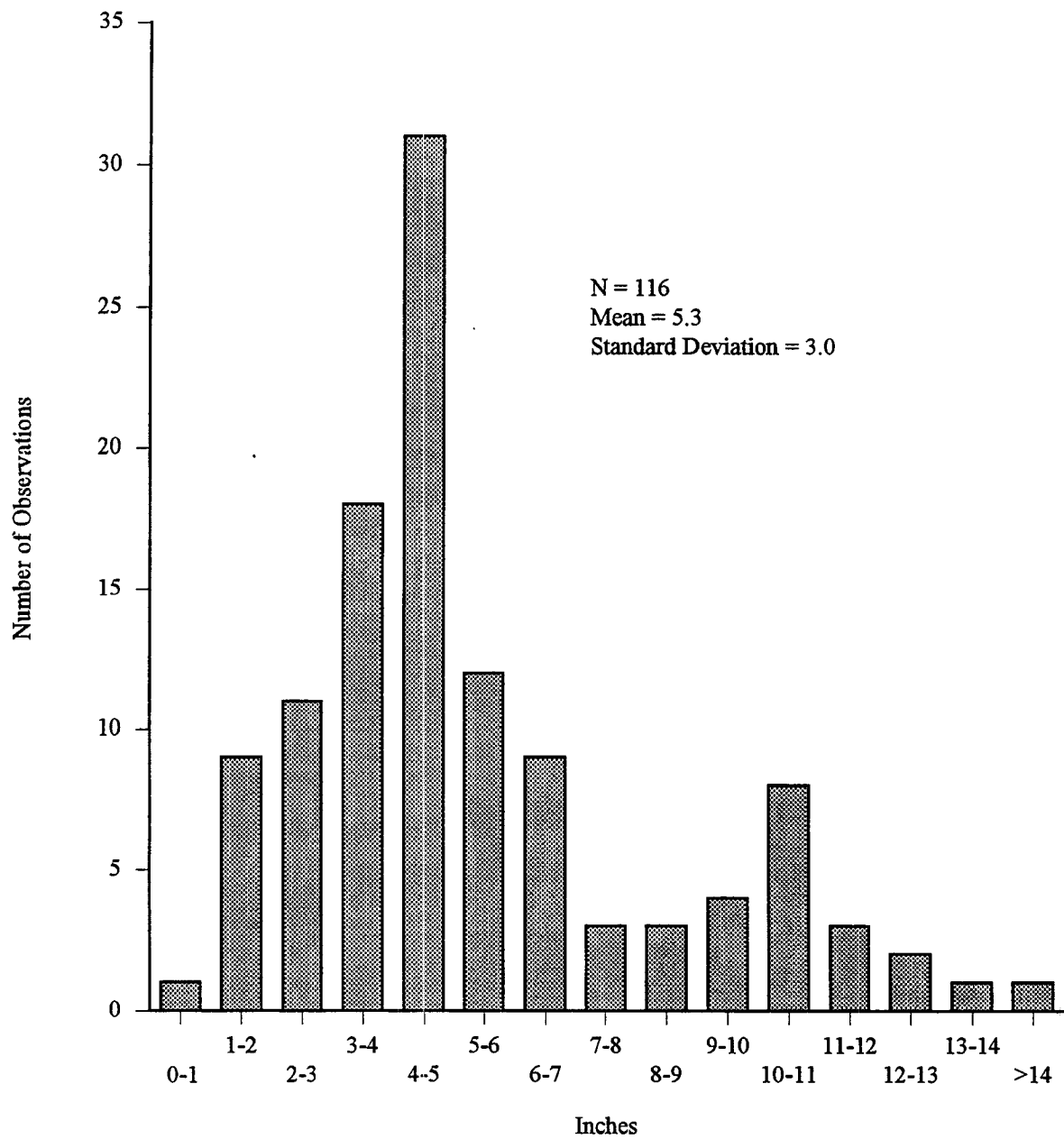
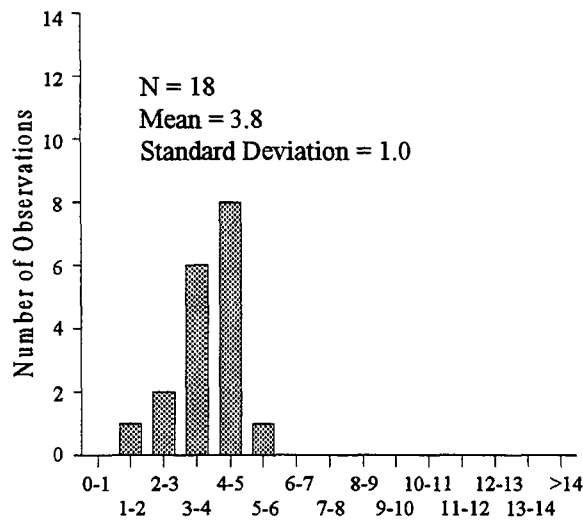
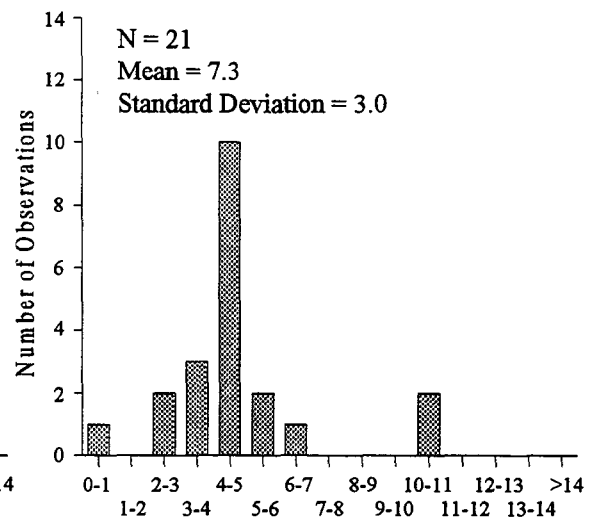


Figure 3.13. Distribution of HMAC Thickness for GPS-2 Test Sections



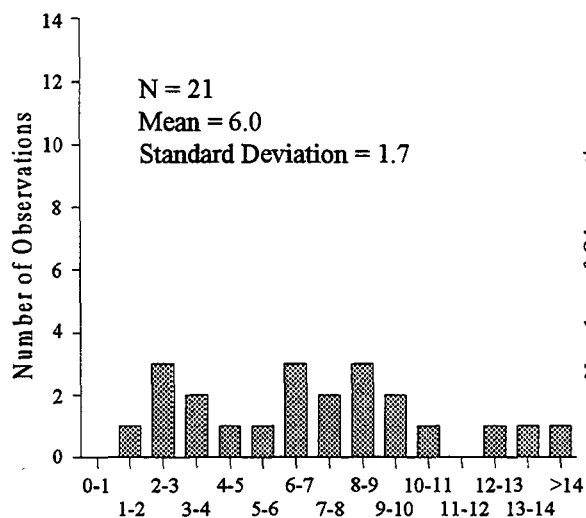
Inches

A. Dry-Freeze



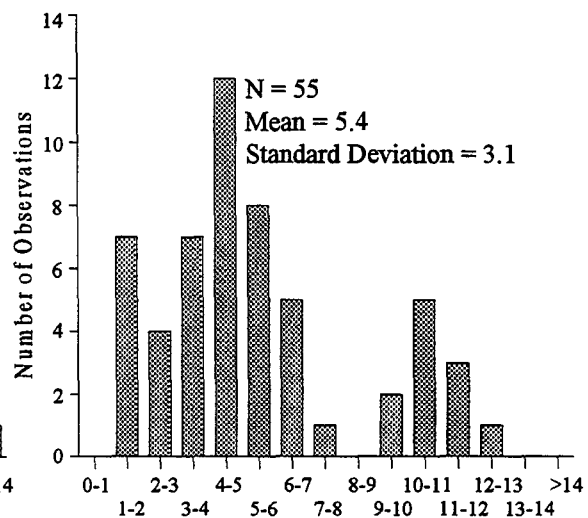
Inches

B. Dry-No Freeze



Inches

C. Wet-Freeze



Inches

D. Wet-No Freeze

Figure 3.14. Distributions of HMAC Thickness by Environmental Regions for GPS-2 Test Sections

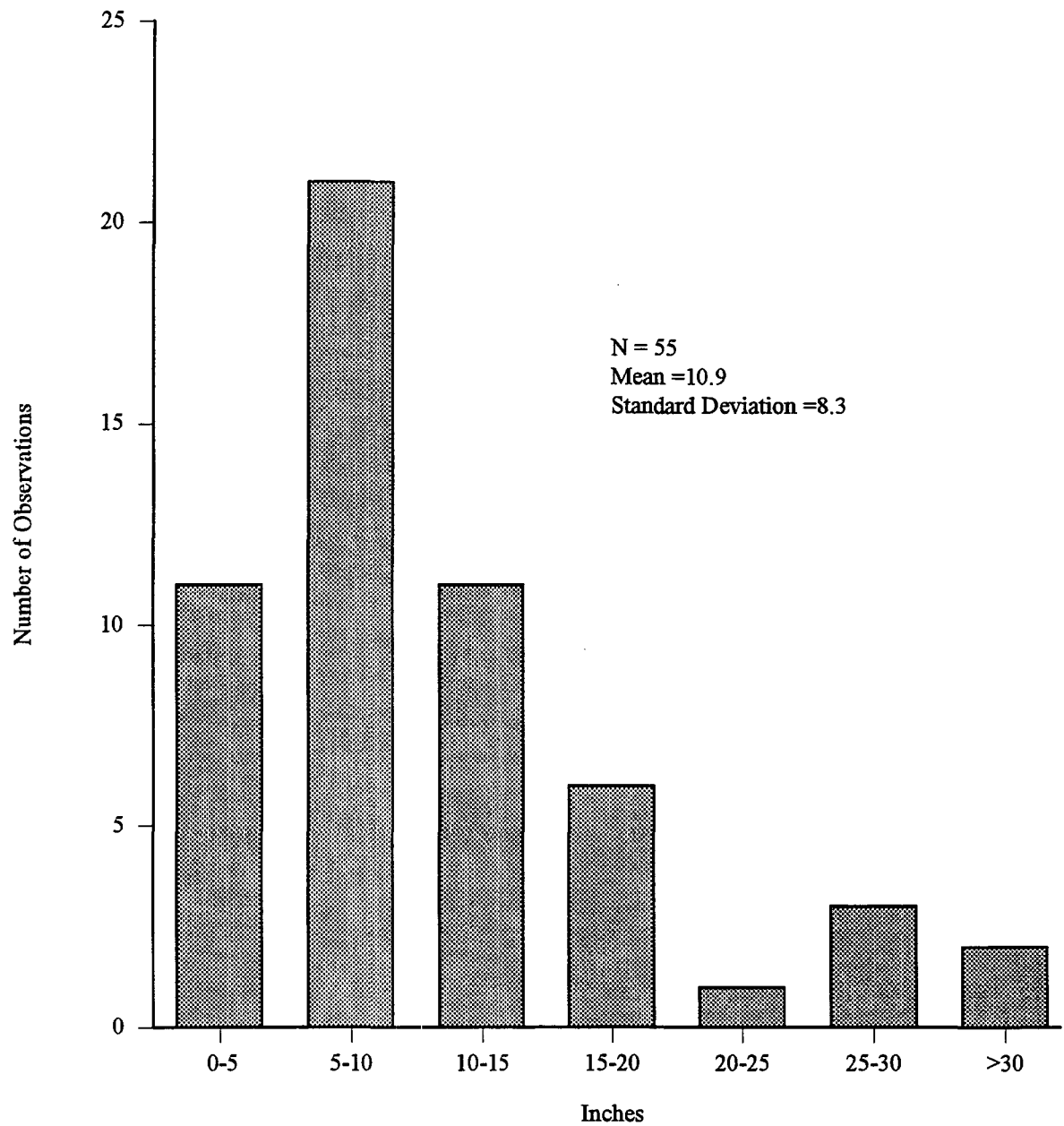
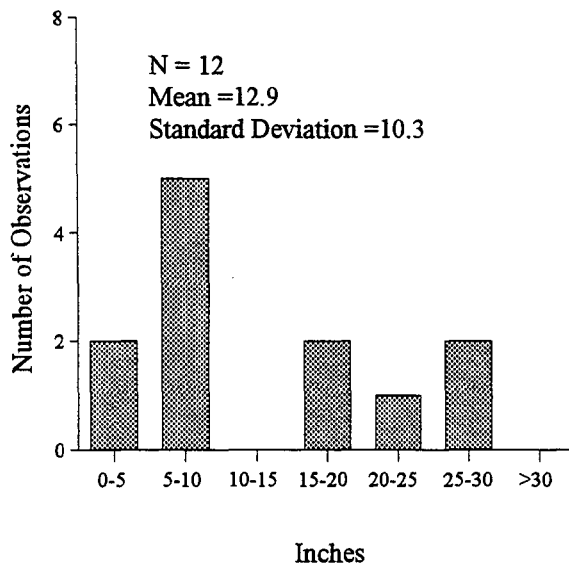
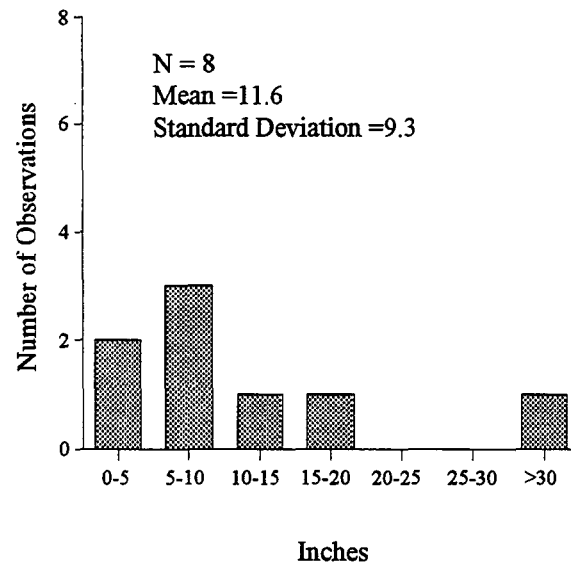


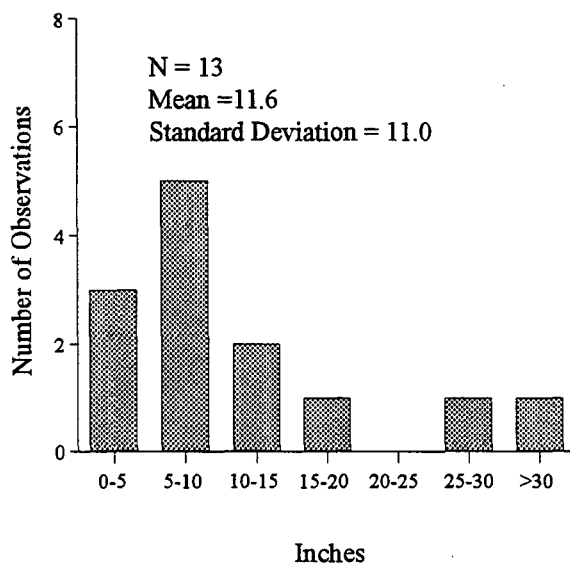
Figure 3.15. Distribution of the Granular Subbase Thickness for GPS-2 Test Sections



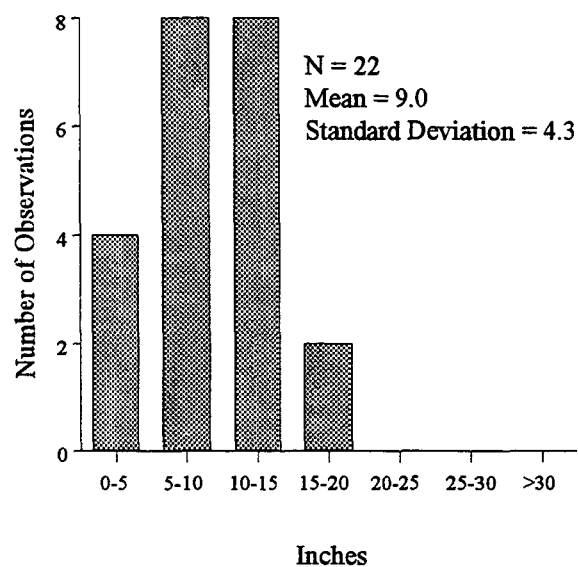
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 3.16. Distributions of Granular Subbase Thickness by Environmental Regions for GPS-2 Test Sections

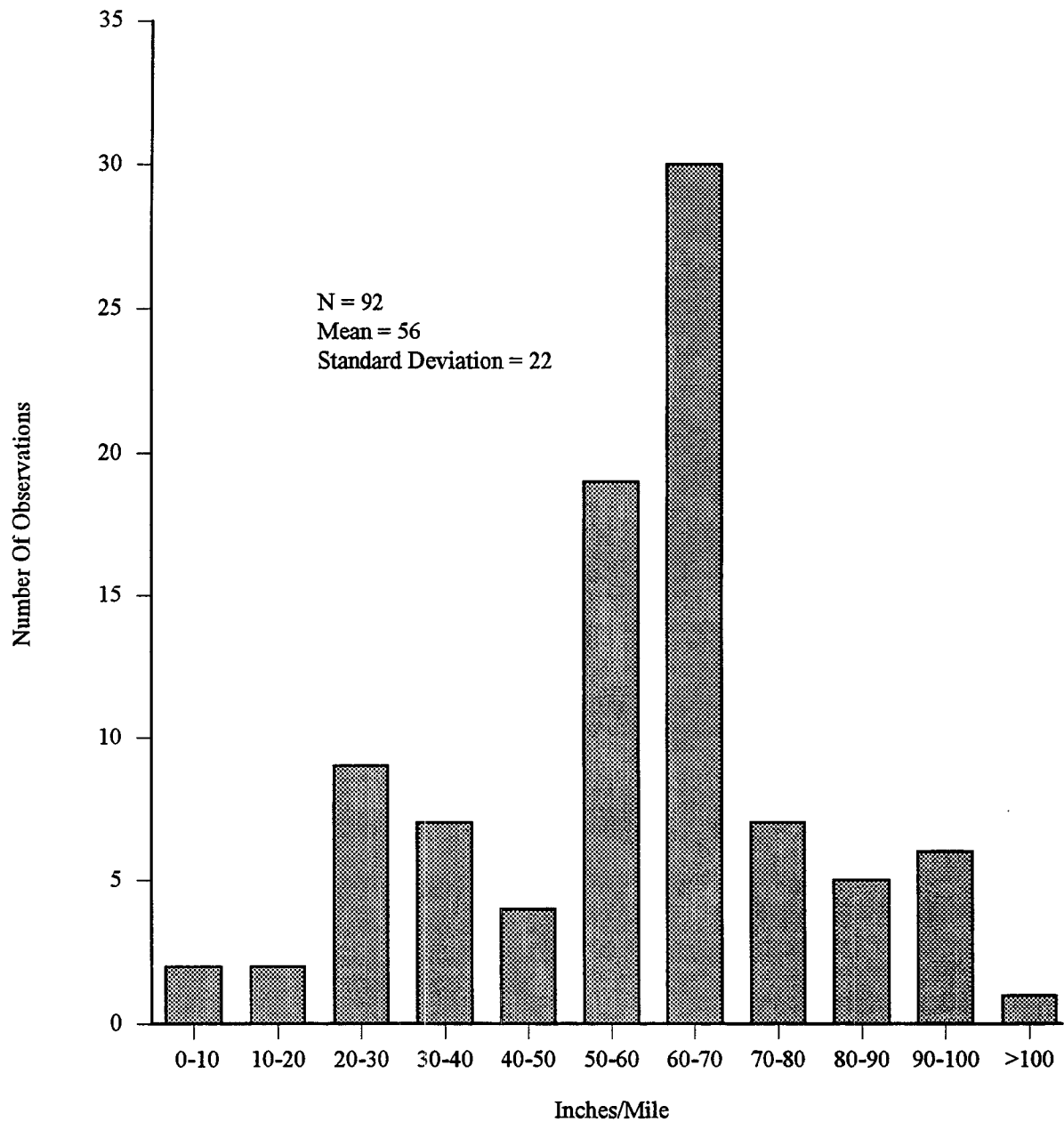
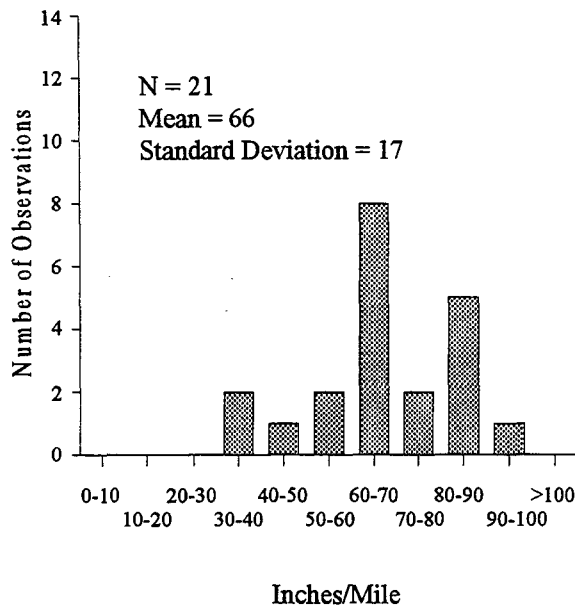
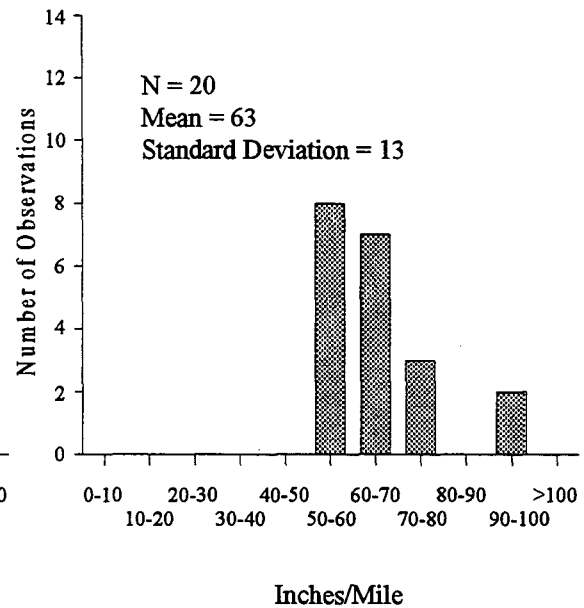


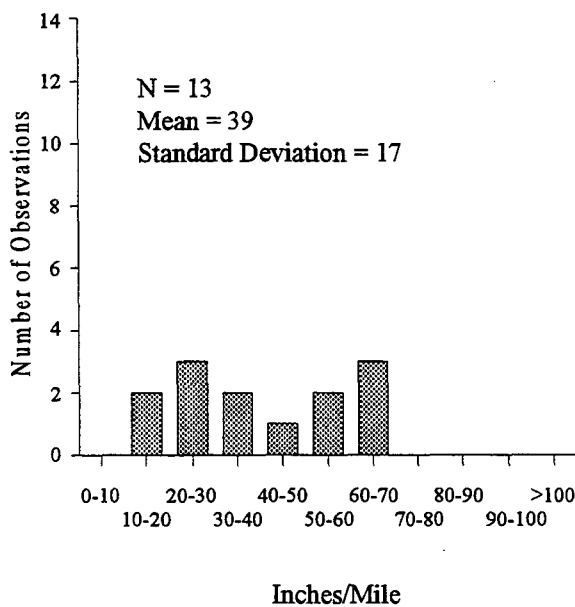
Figure 3.17. Distribution of Initial International Roughness Index (IRI) for GPS-2 Test Sections



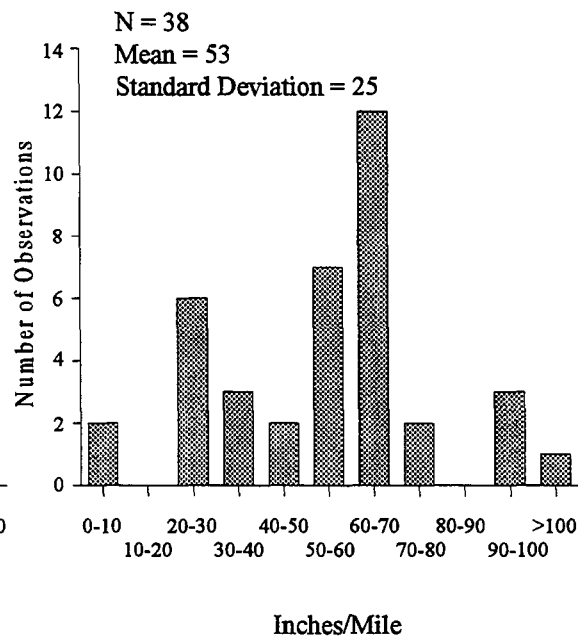
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 3.18. Distributions of Initial International Roughness Index (IRI) by Environmental Regions for GPS-2 Test Sections

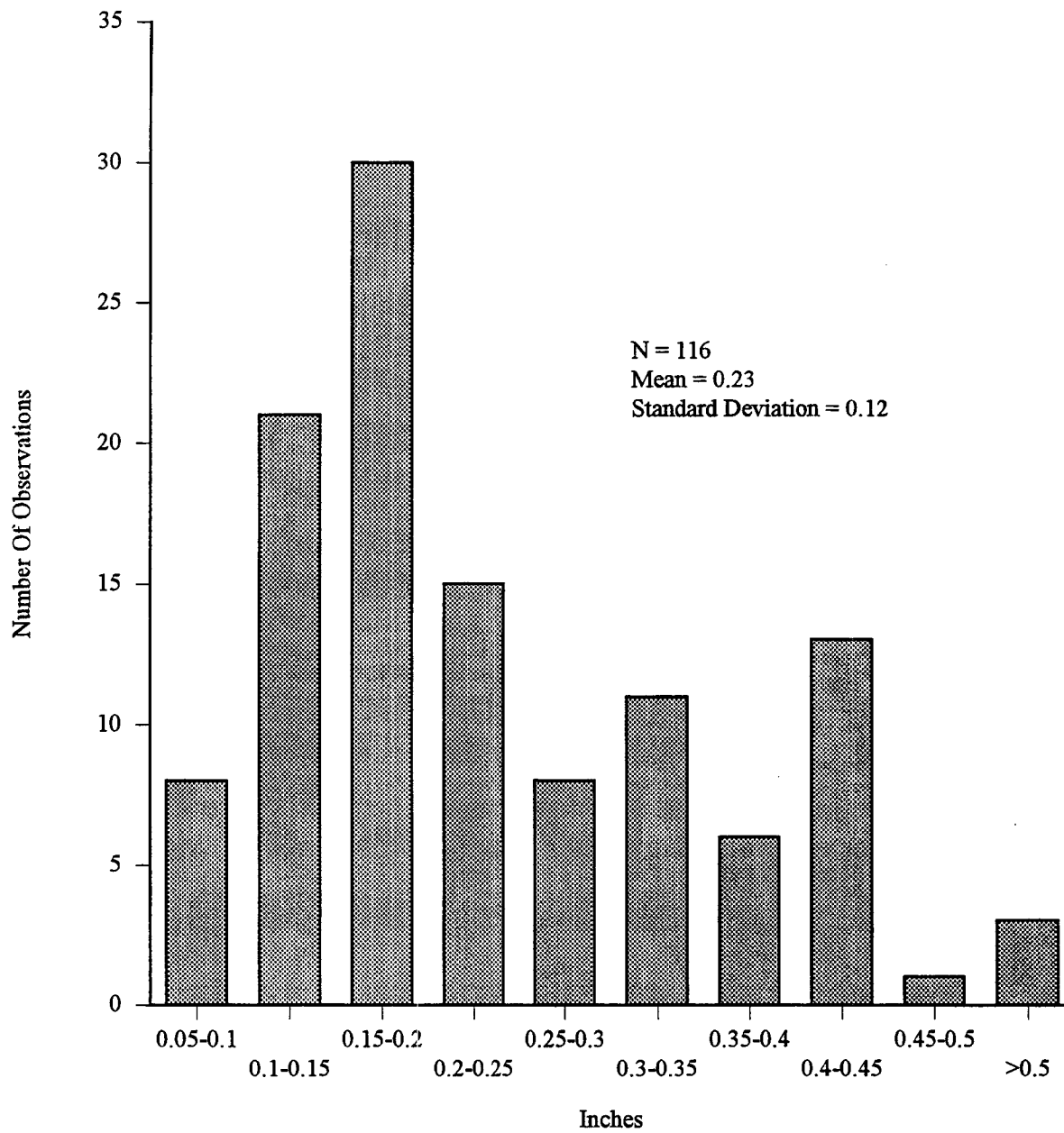
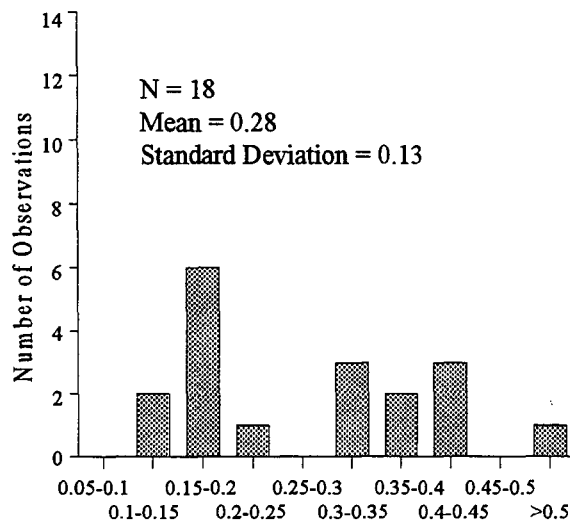
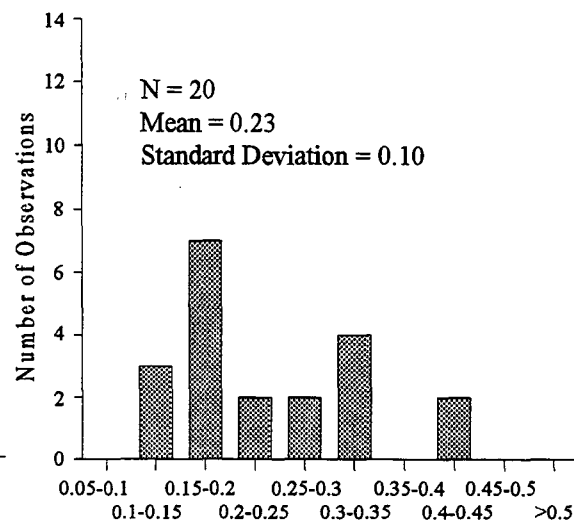


Figure 3.19. Distribution of Rut Depth for GPS-2 Test Sections



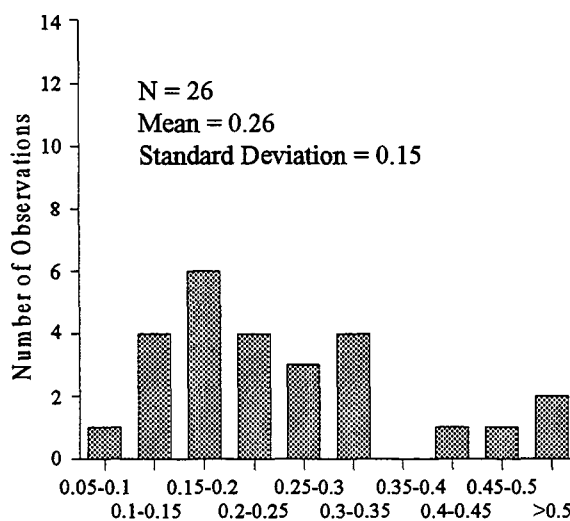
Inches

A. Dry-Freeze



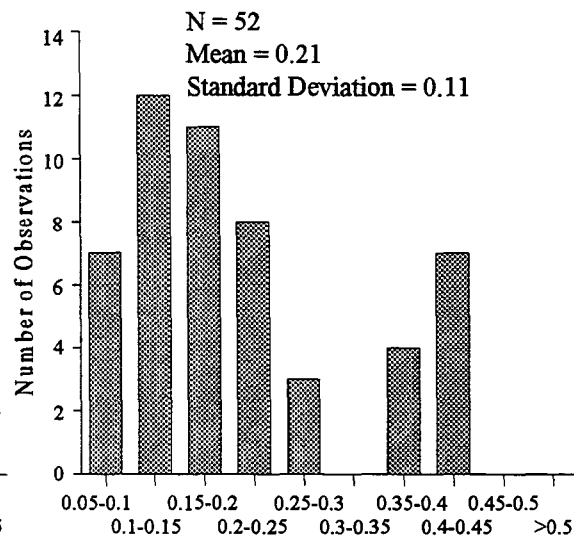
Inches

B. Dry-No Freeze



Inches

C. Wet-Freeze



Inches

D. Wet-No Freeze

Figure 3.20. Distributions of Rut Depth by Environmental Regions for GPS-2 Test Sections

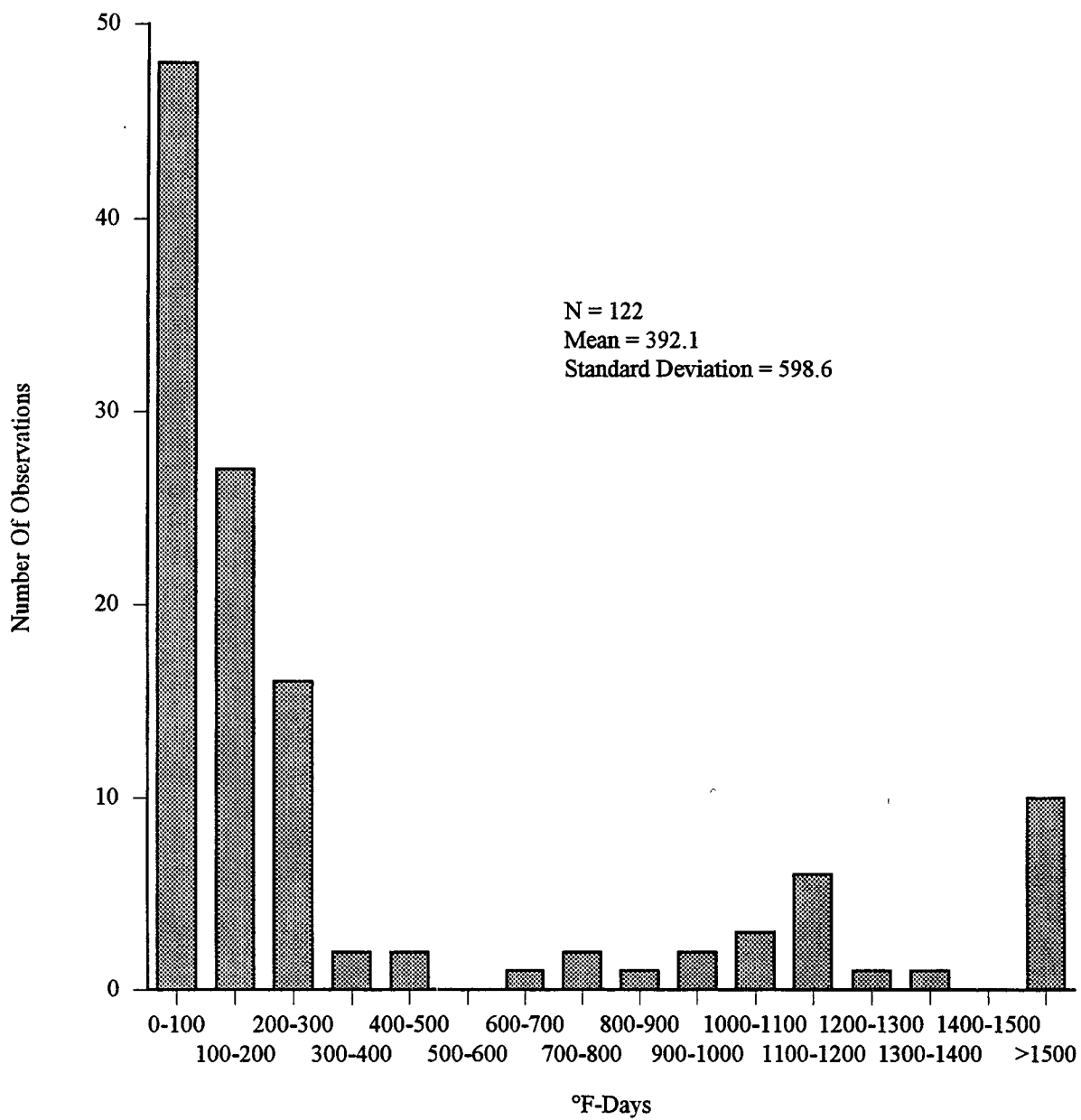


Figure 3.21. Distribution of Freeze Index for GPS-2 Test Sections

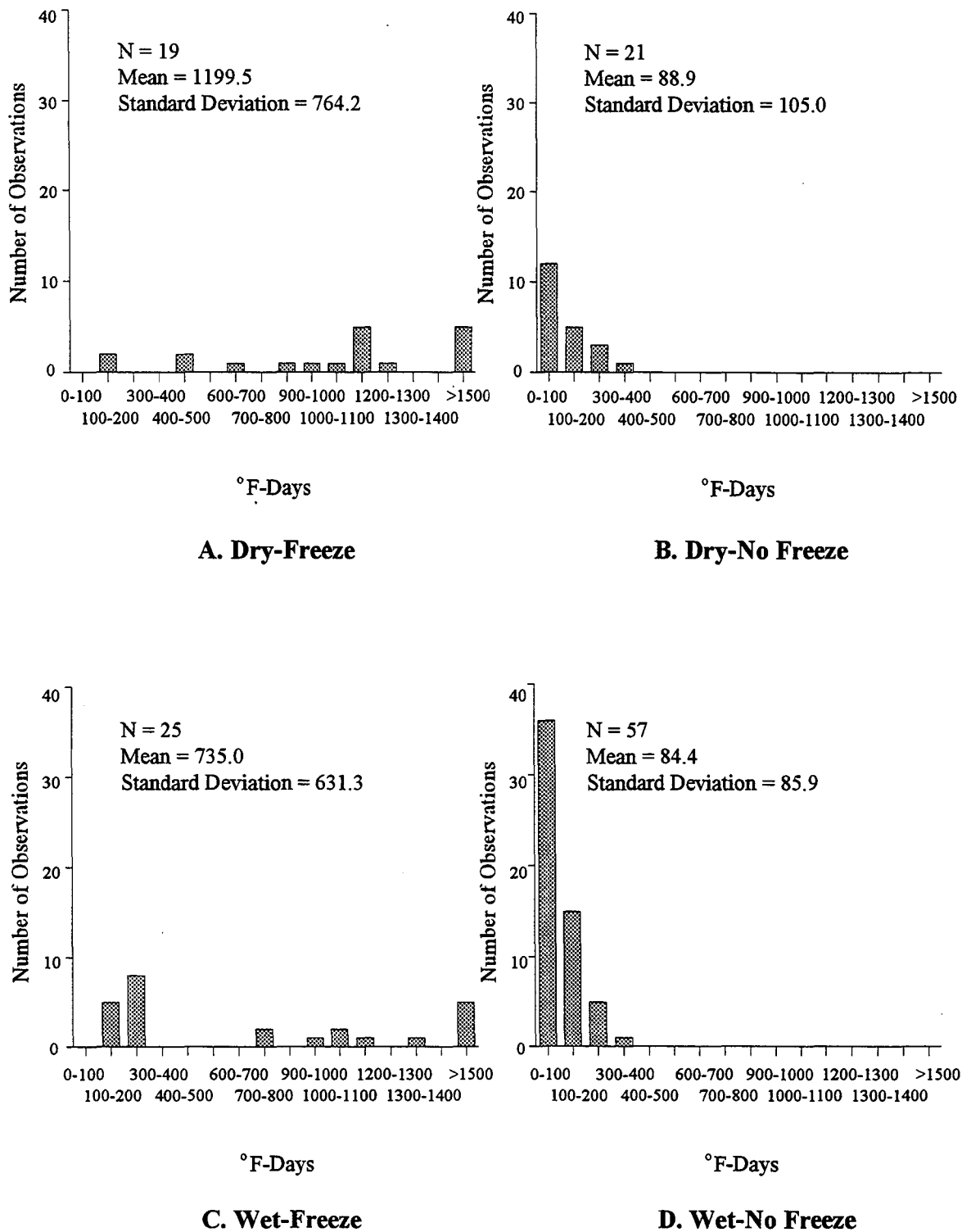


Figure 3.22. Distributions of Freeze Index by Environmental Regions for GPS-2 Test Sections

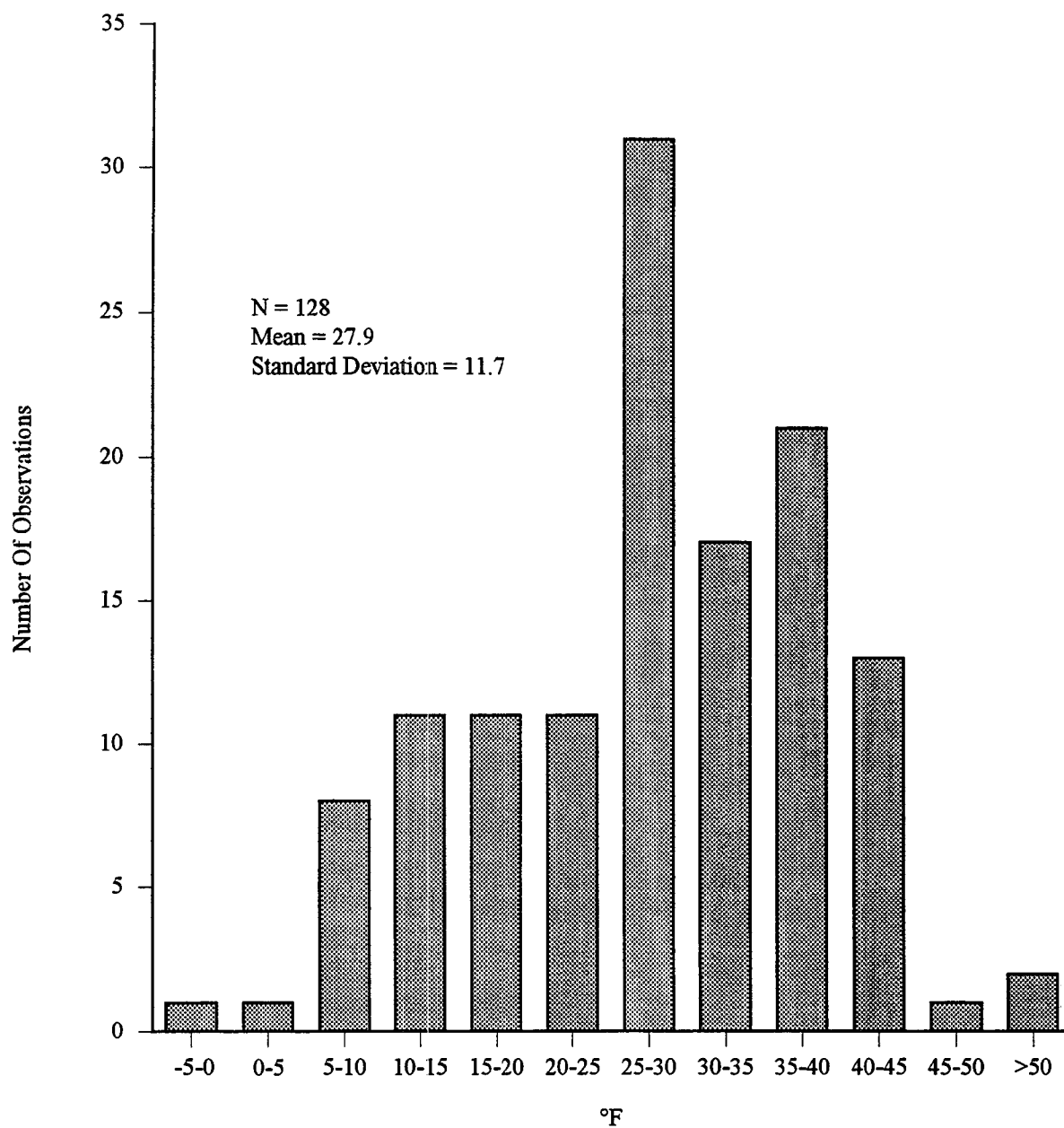
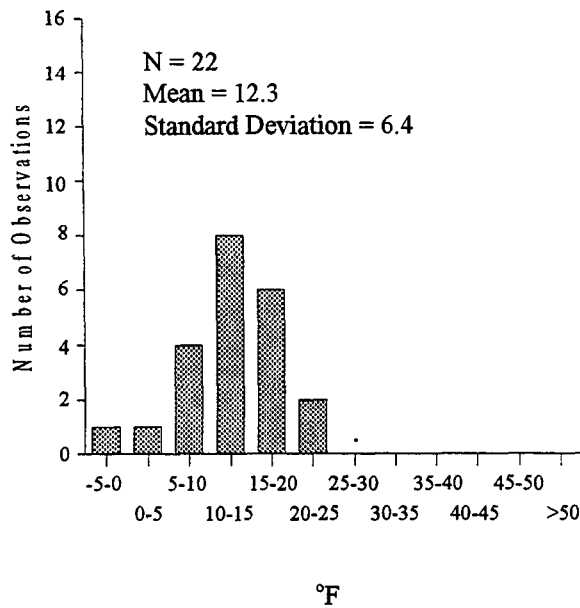
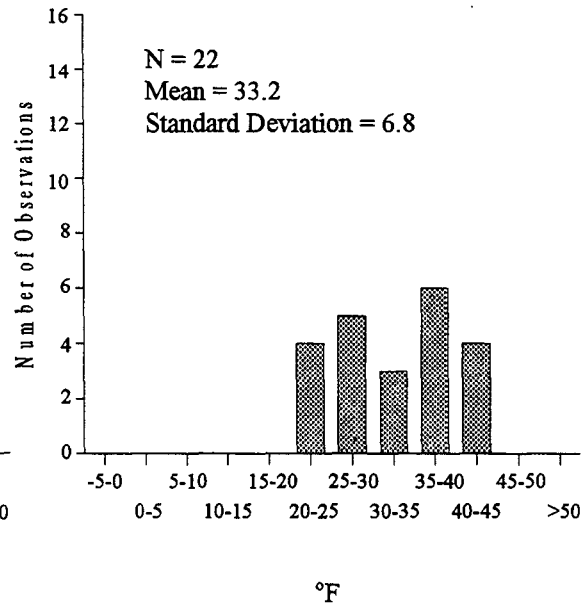


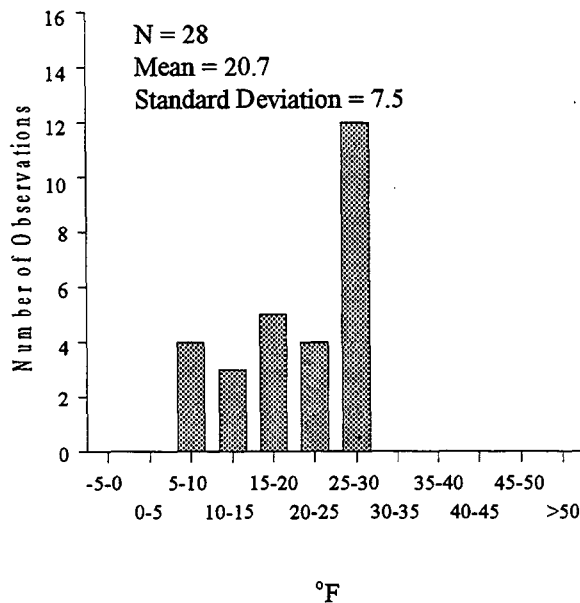
Figure 3.23. Distribution of Average Annual Minumum Temperature (for the Months of December, January and February) for GPS-2 Test Sections



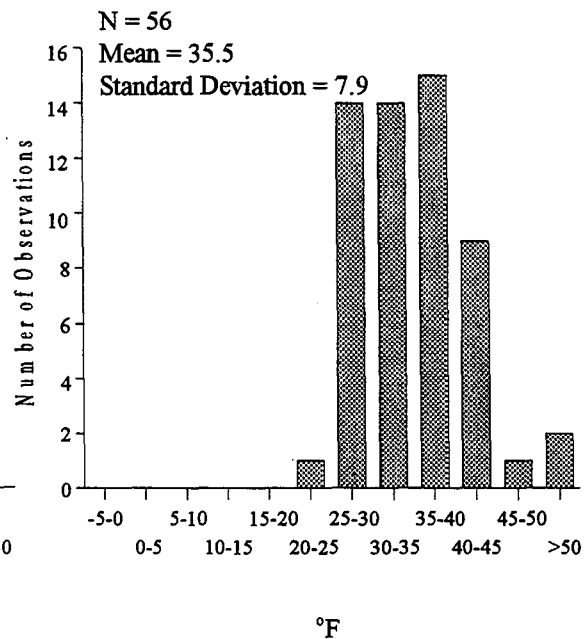
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 3.24. Distributions of Average Annual Minimum Temperature (for the Months of December, January and February) by Environmental Regions for GPS-2 Test Sections

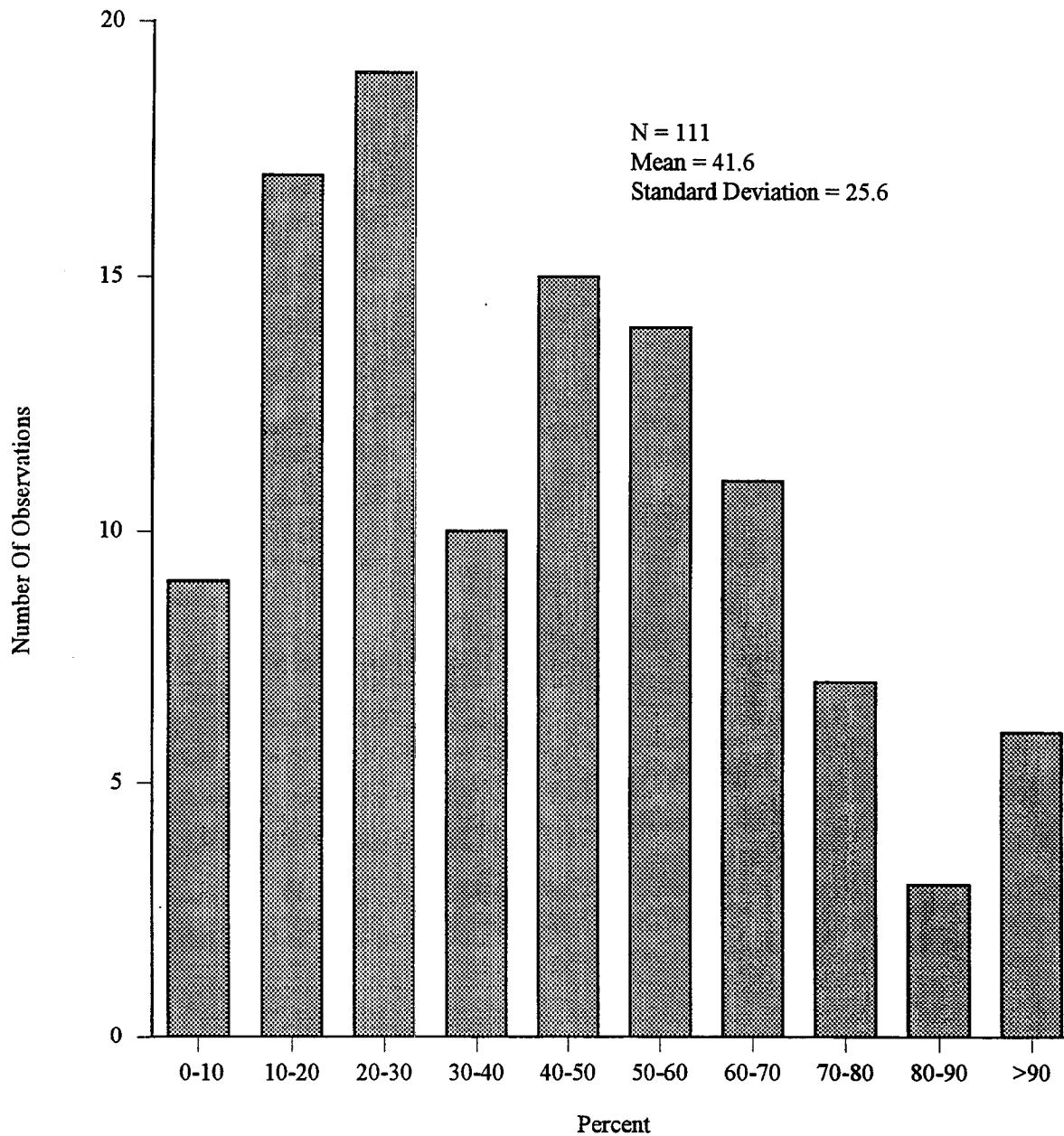
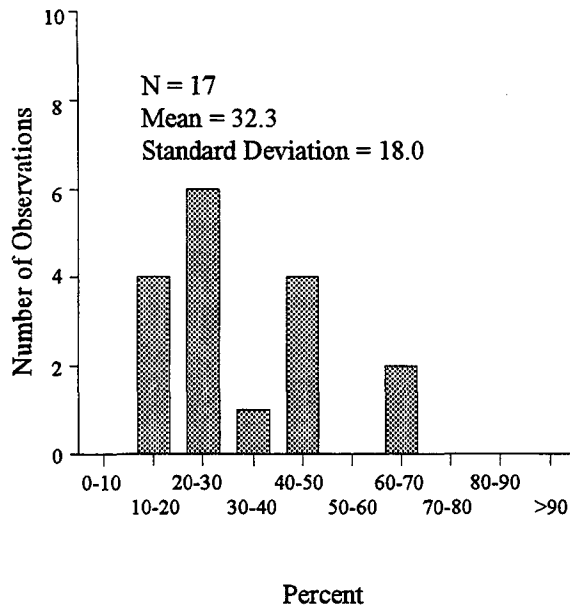
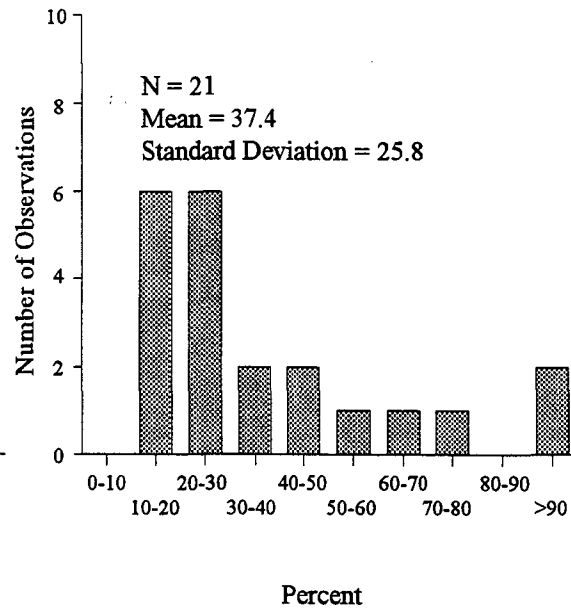


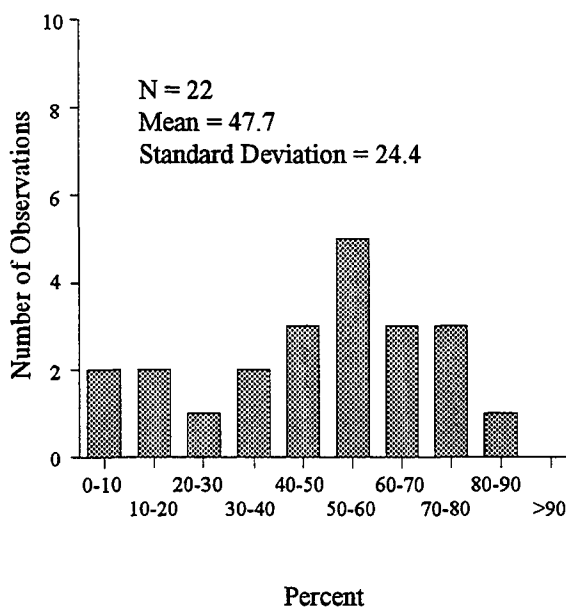
Figure 3.25. Distribution of Subgrade Passing the Number 200 Sieve for GPS-2 Test Sections



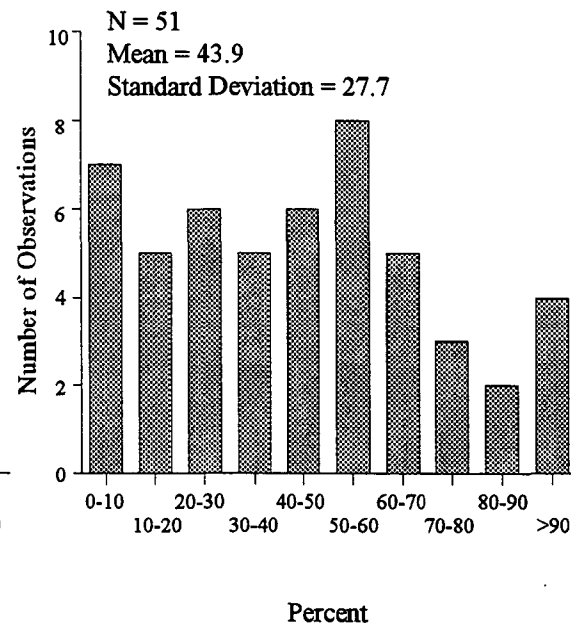
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 3.26. Distributions of Subgrade Passing the Number 200 Sieve by Environmental Regions for GPS-2 Test Sections

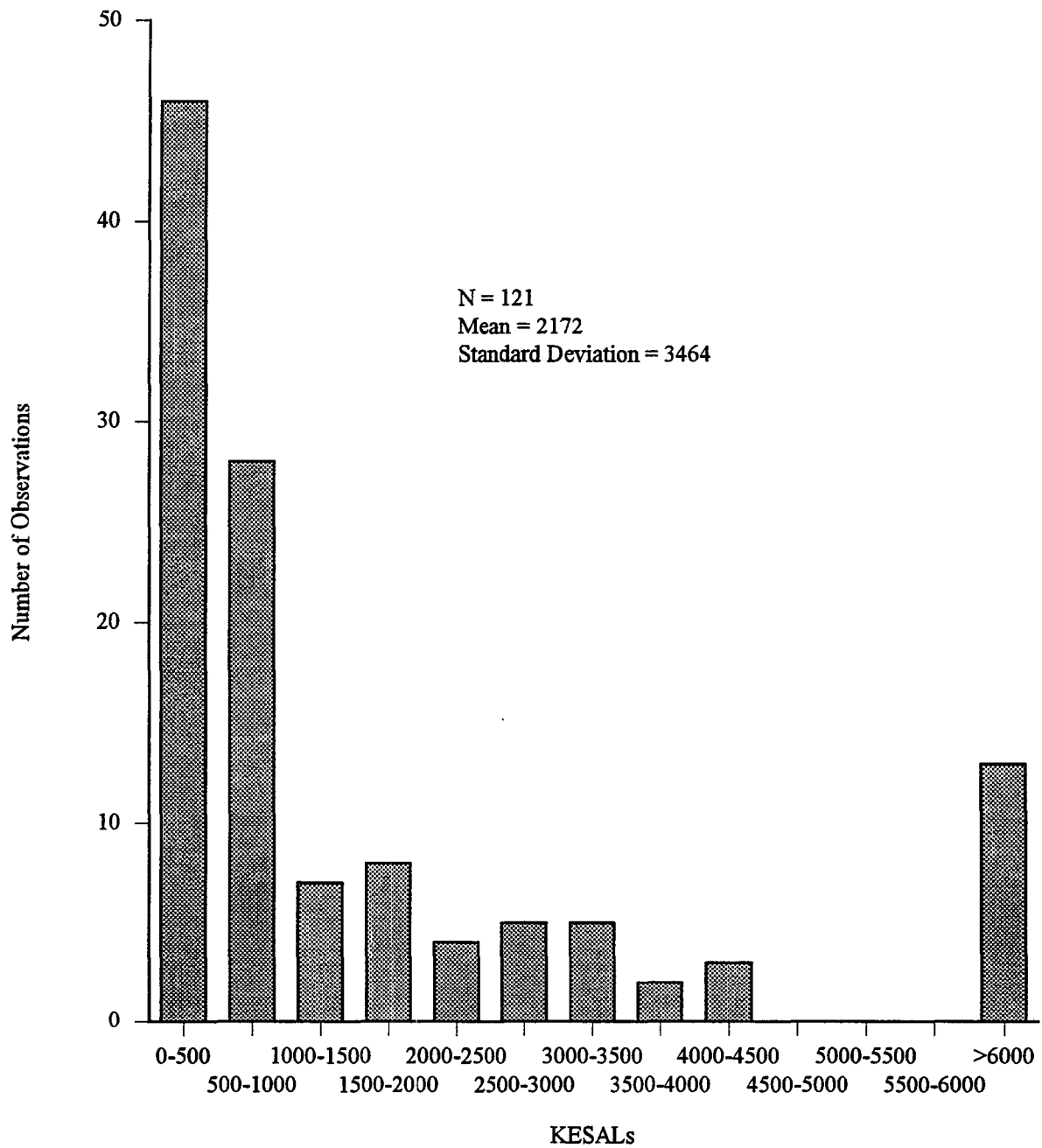


Figure 3.27. Distribution of Cumulative Equivalent Single Axle Loads in Thousands (KESALs) for GPS-2 Test Sections

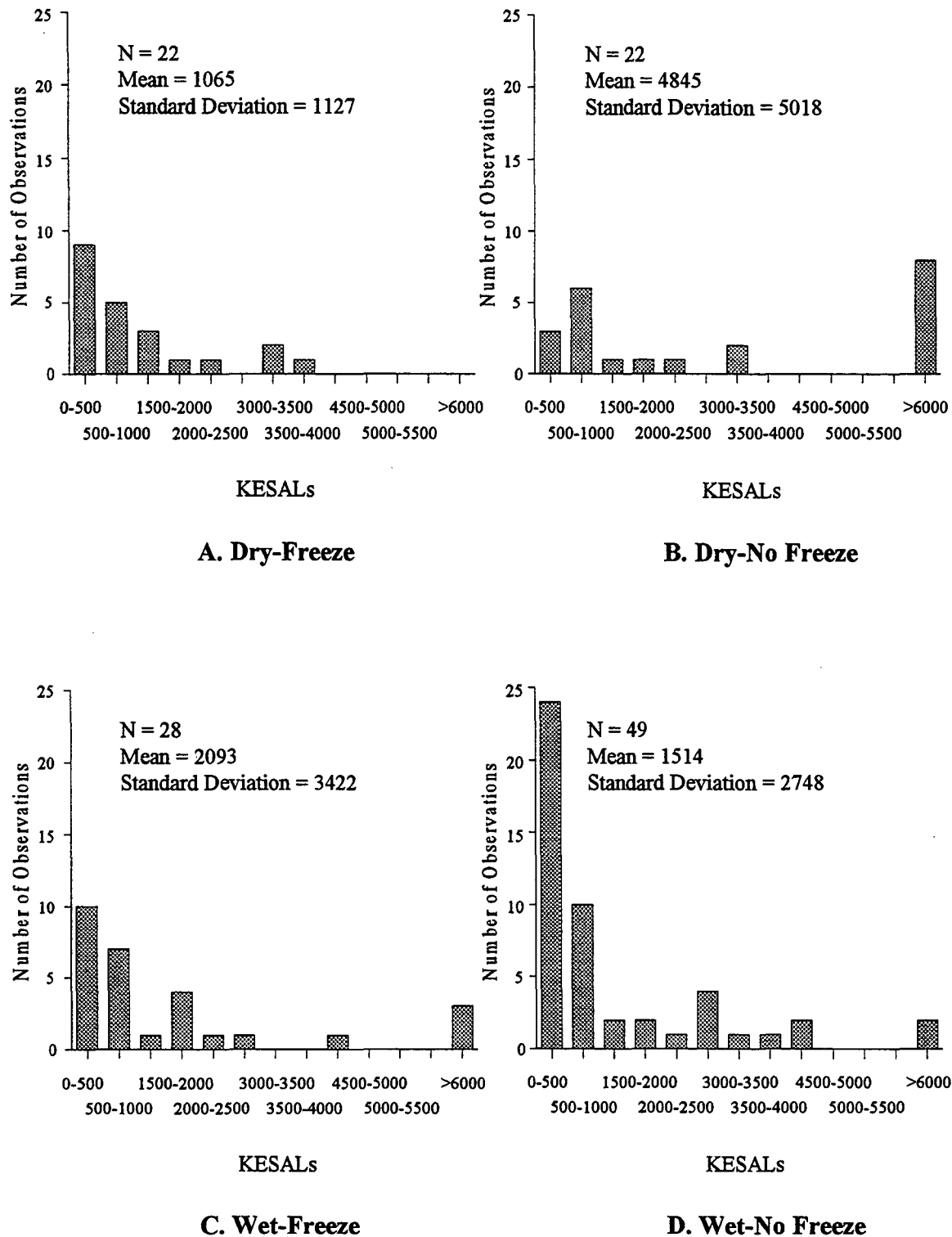


Figure 3.28. Distributions of Cumulative Equivalent Single Axle Loads in Thousands (KESALs) by Environmental Regions for GPS-2 Test Sections

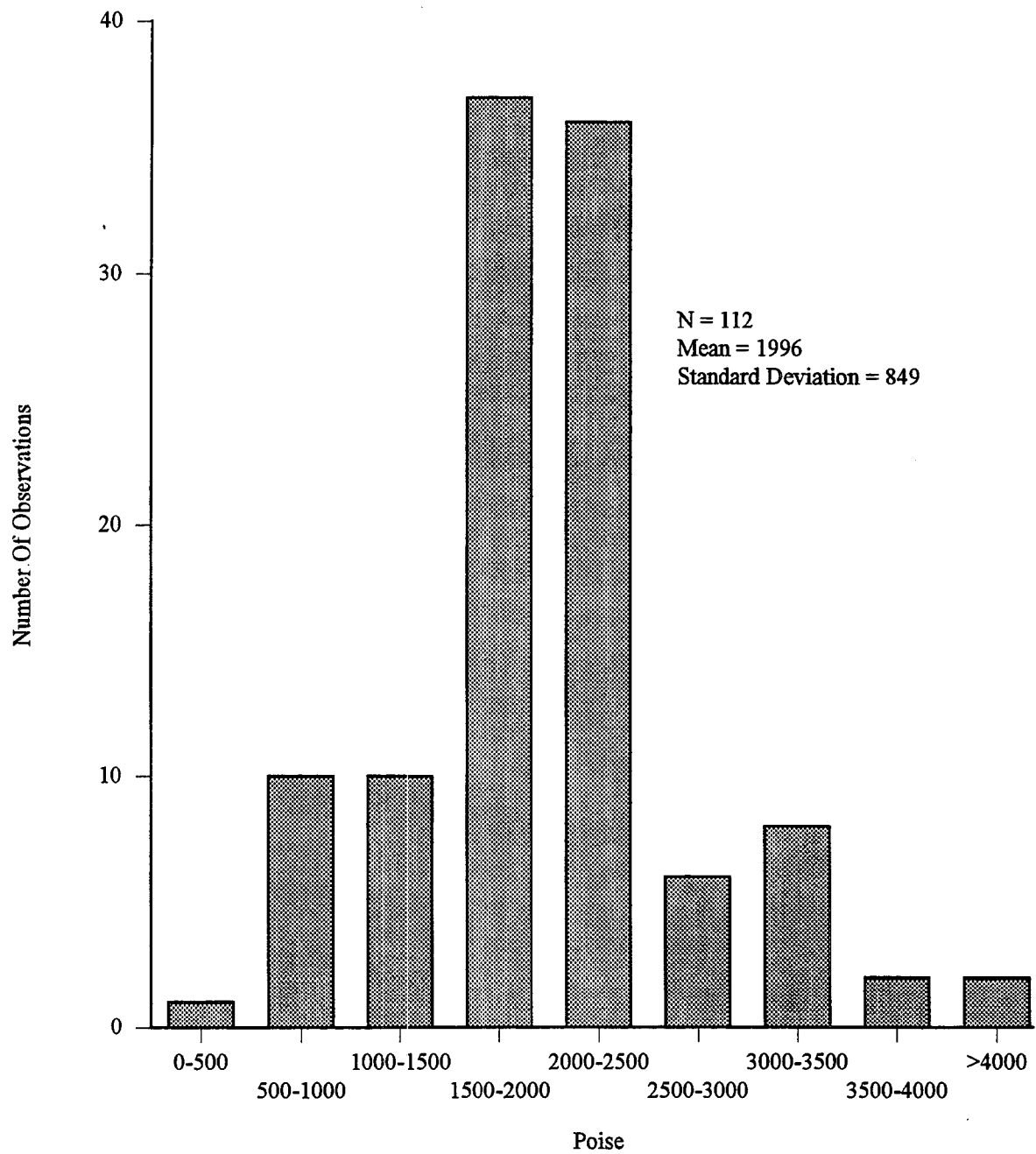
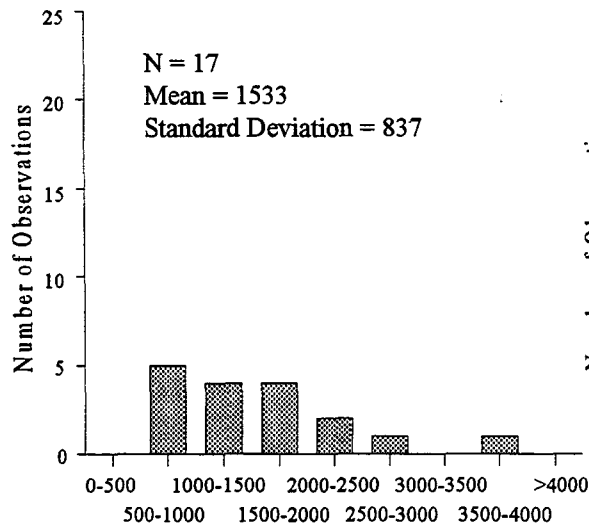
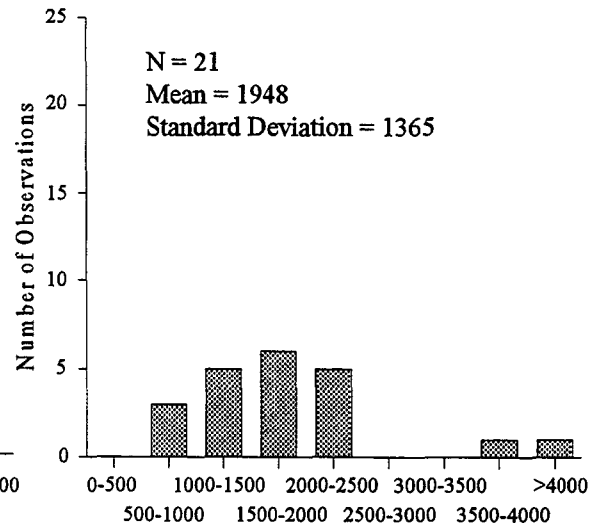


Figure 3.29. Distribution of Asphalt Cement Viscosity at 140°F for GPS-2 Test Sections



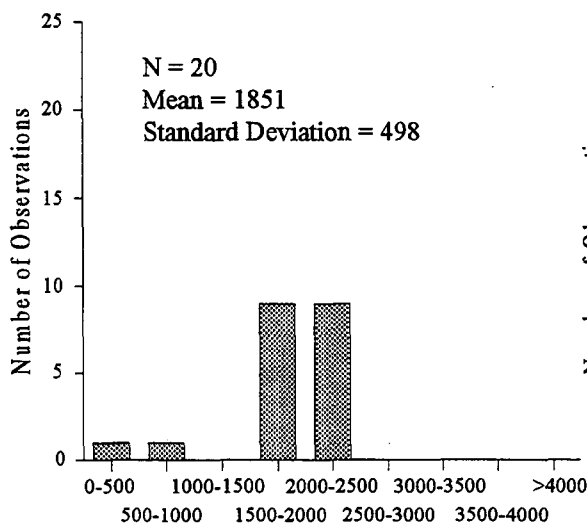
Poise

A. Dry-Freeze



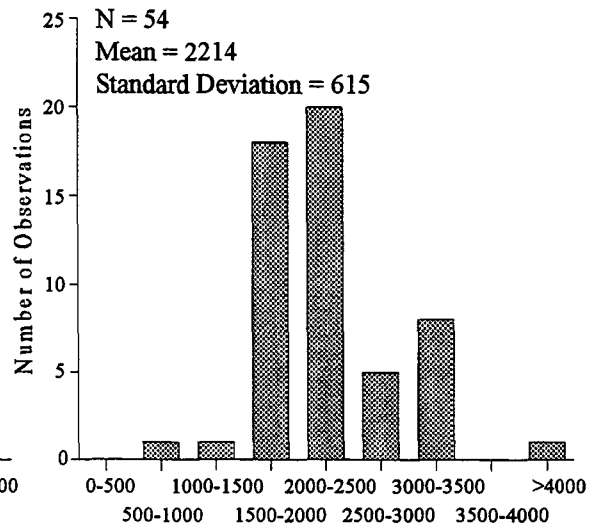
Poise

B. Dry-No Freeze



Poise

C. Wet-Freeze



Poise

D. Wet-No Freeze

Figure 3.30. Distributions of Asphalt Cement Viscosity at 140°F by Environmental Regions for GPS-2 Test Sections

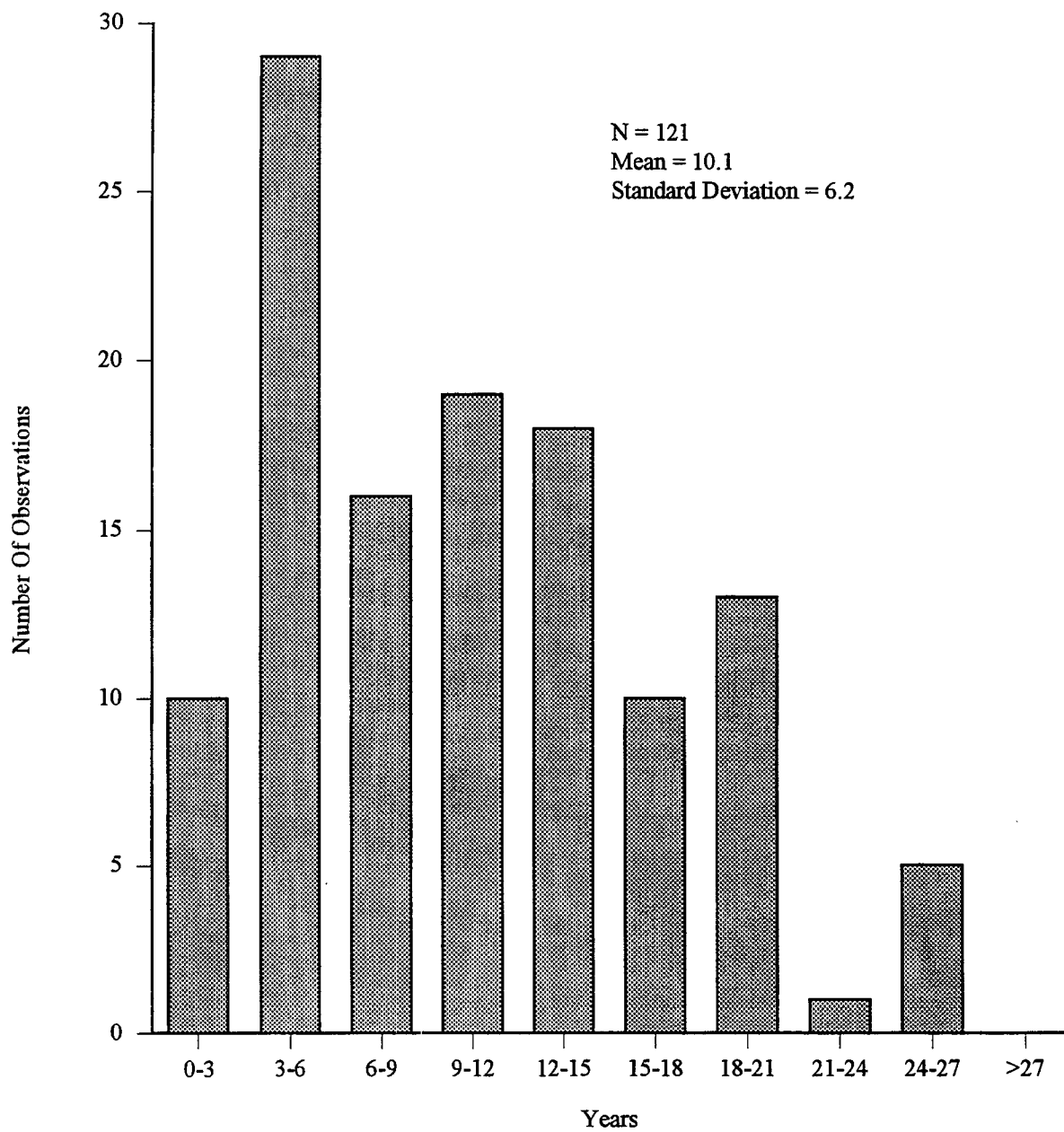
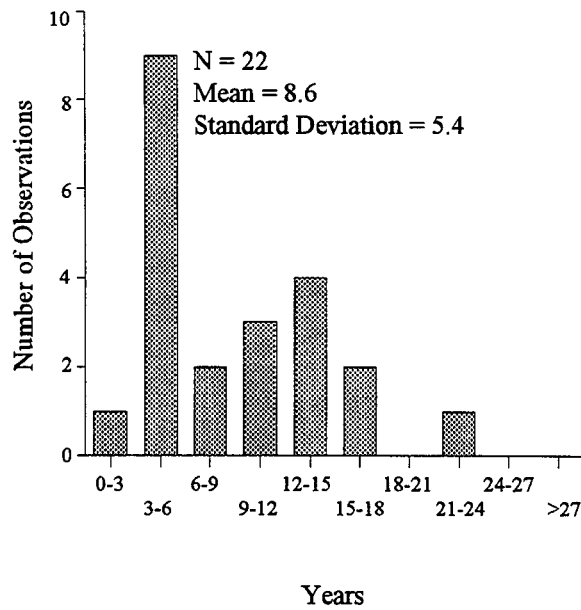
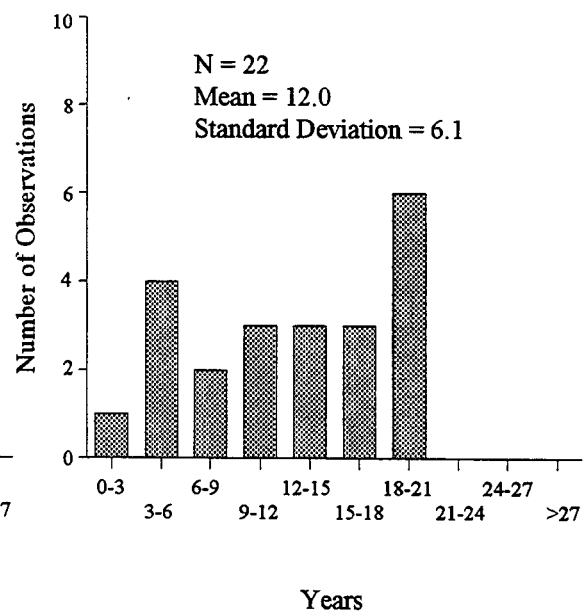


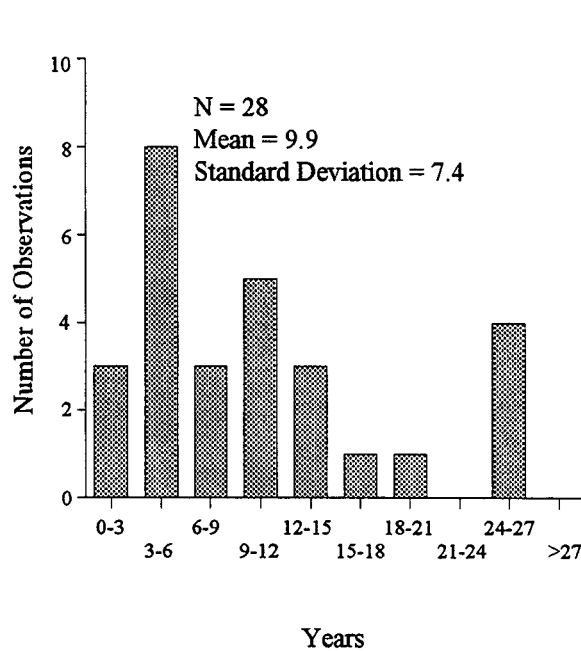
Figure 3.31. Distribution of Age for GPS-2 Test Sections



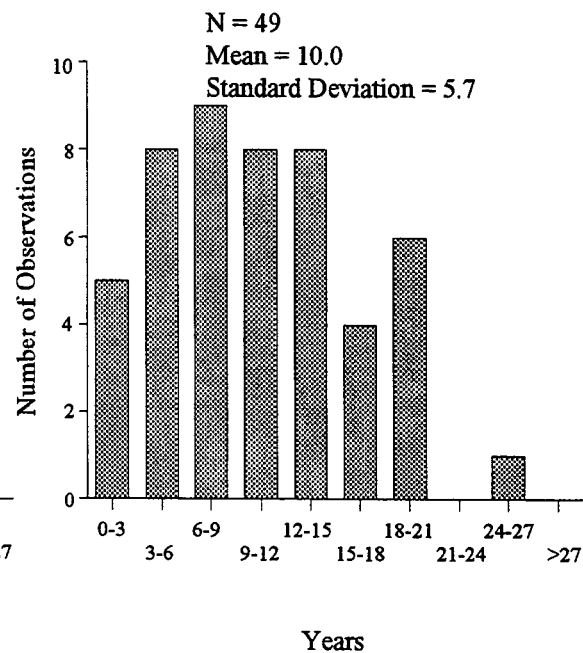
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 3.32. Distributions of Age by Environmental Regions for GPS-2 Test Sections

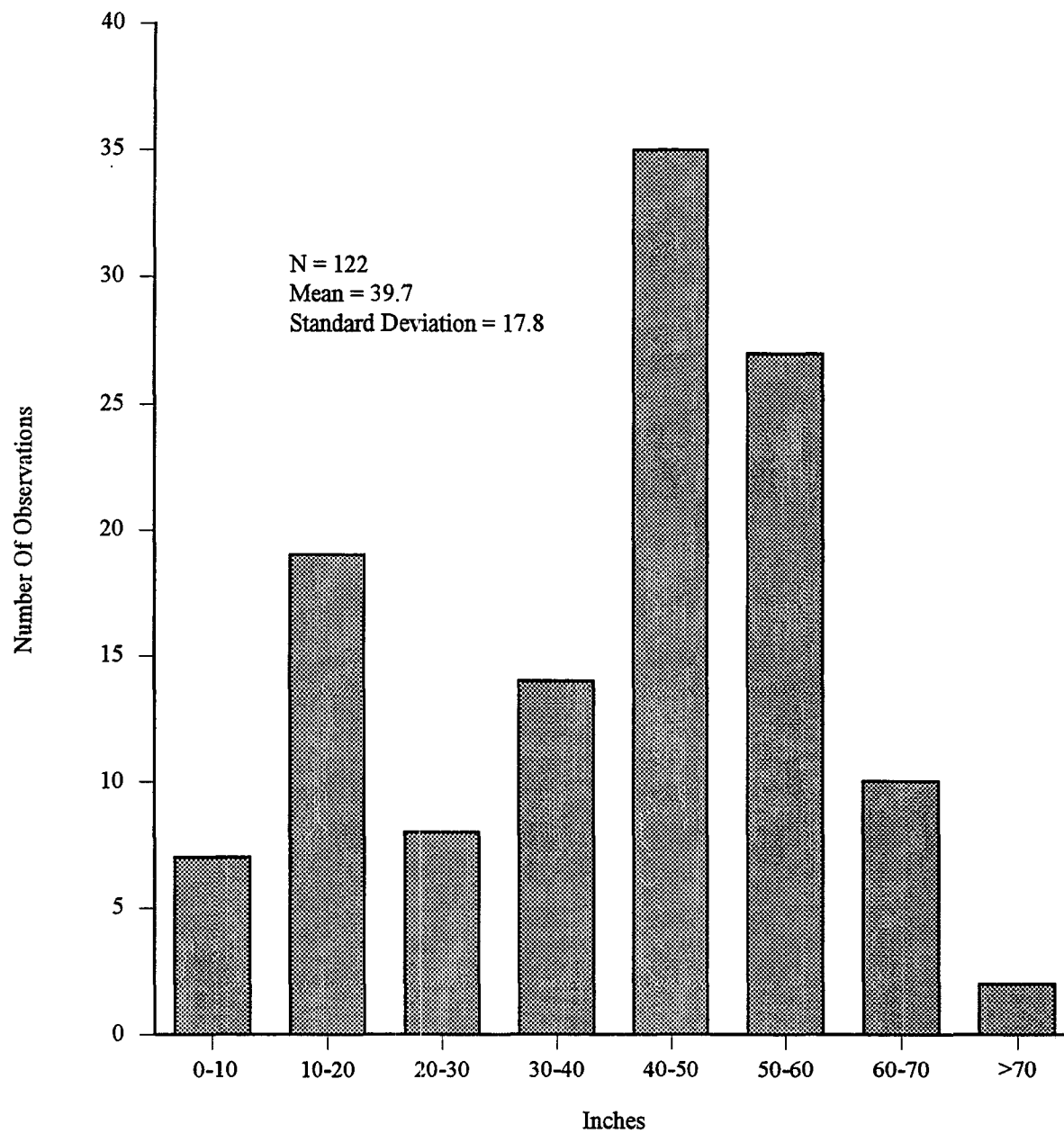
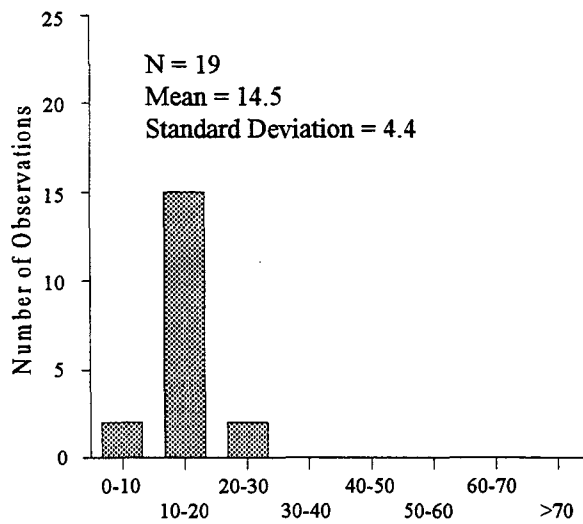
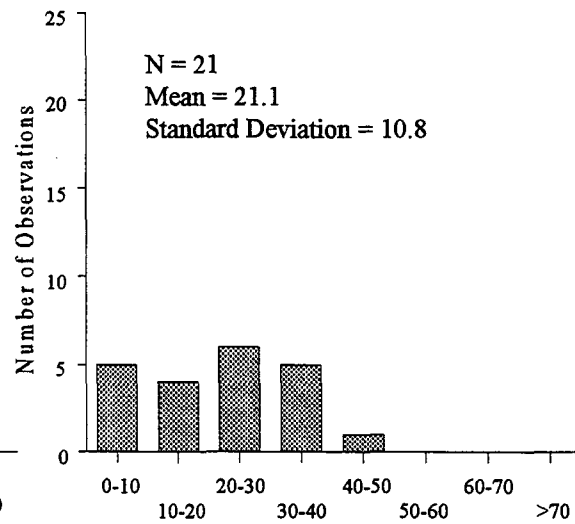


Figure 3.33. Distribution of Annual Average Precipitation for GPS-2 Test Sections



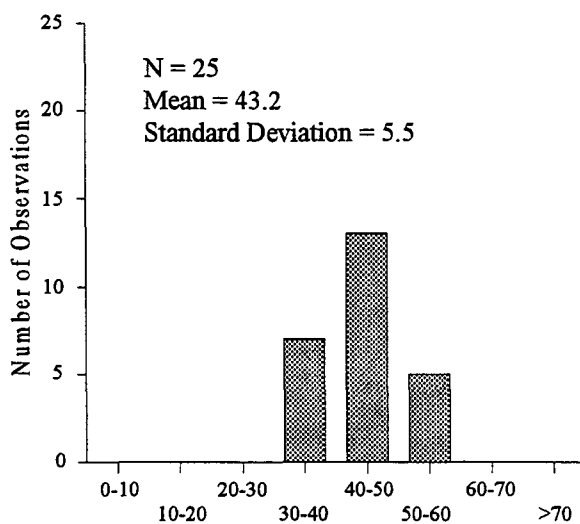
Inches

A. Dry-Freeze



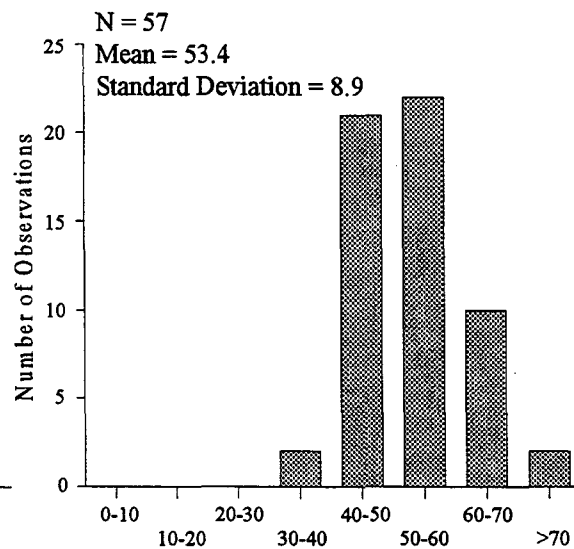
Inches

B. Dry-No Freeze



Inches

C. Wet-Freeze



Inches

D. Wet-No Freeze

Figure 3.34. Distributions of Annual Average Precipitation by Environmental Regions for GPS-2 Test Sections

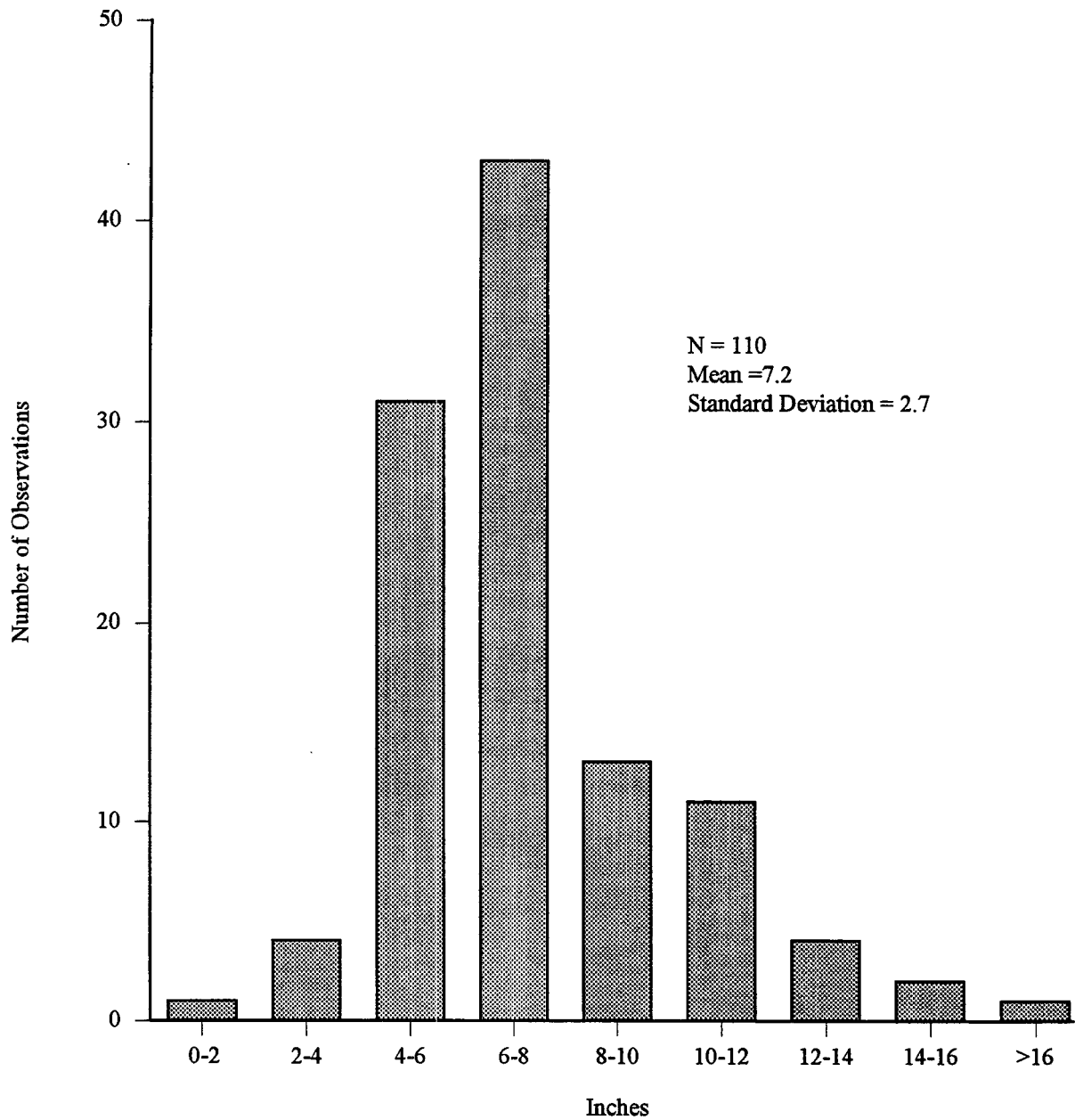


Figure 3.35. Distribution of the Treated-Base Thickness for GPS-2 Test Sections

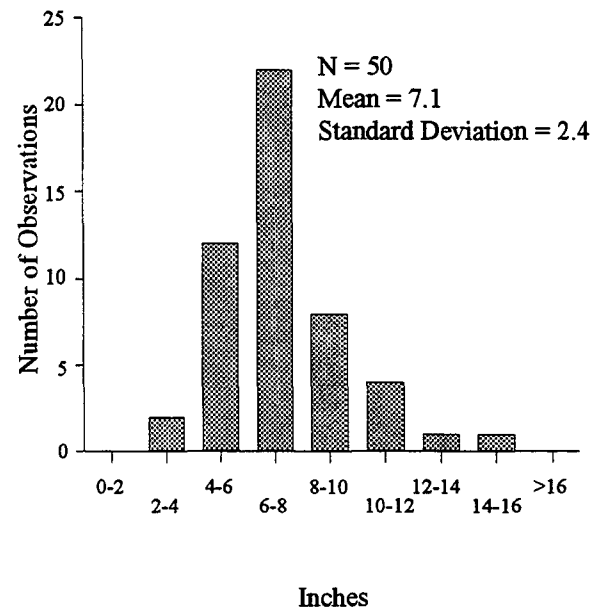
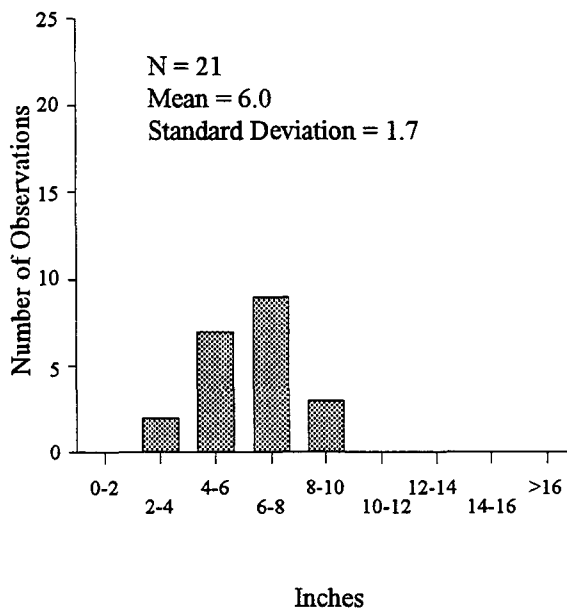
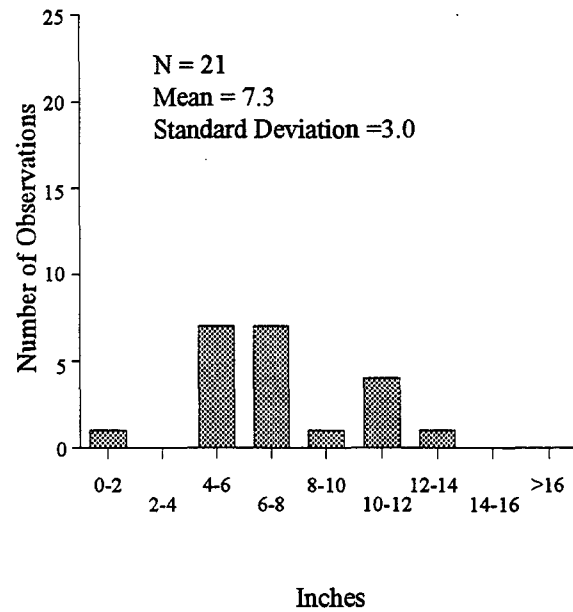
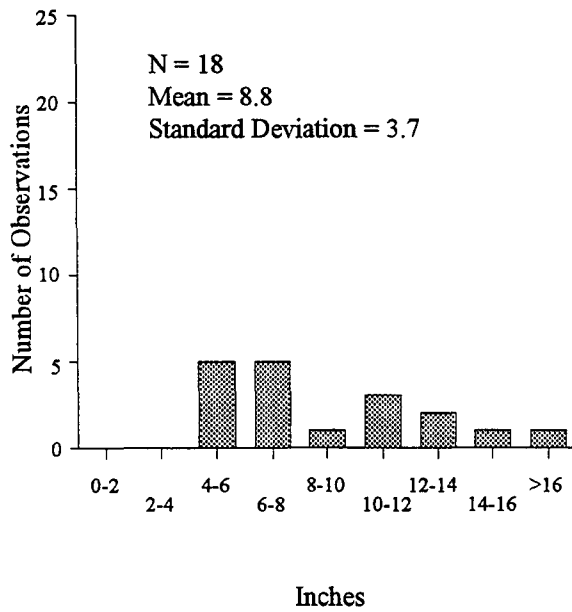


Figure 3.36. Distributions of Treated-Base Thickness by Environmental Regions for GPS-2 Test Sections

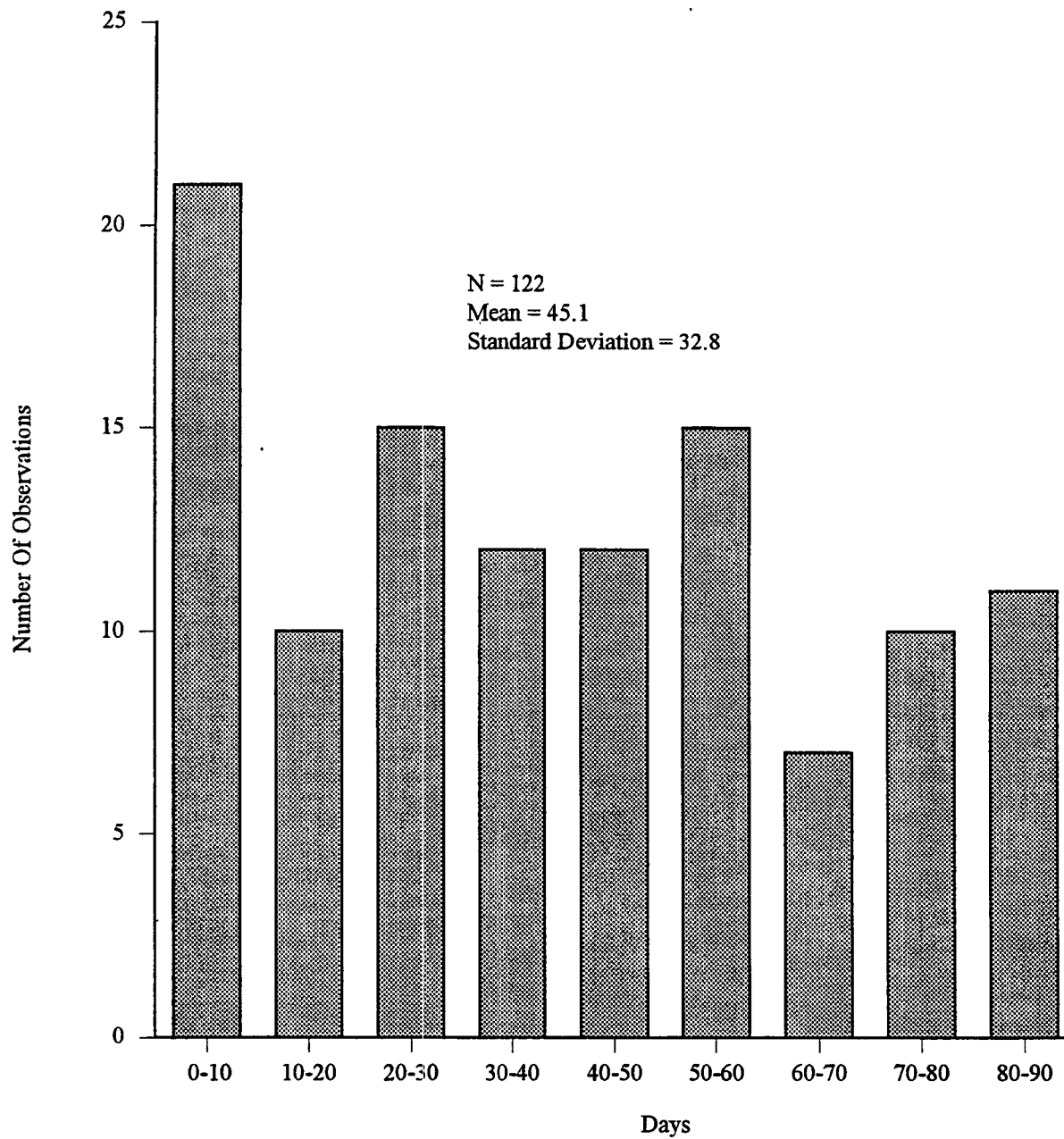


Figure 3.37. Distribution of Annual Average Number of Days Greater Than 90°F for GPS-2 Test Sections

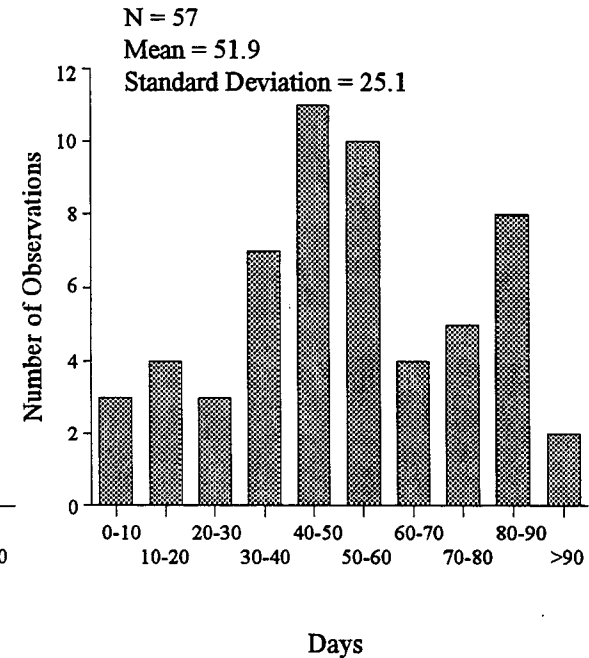
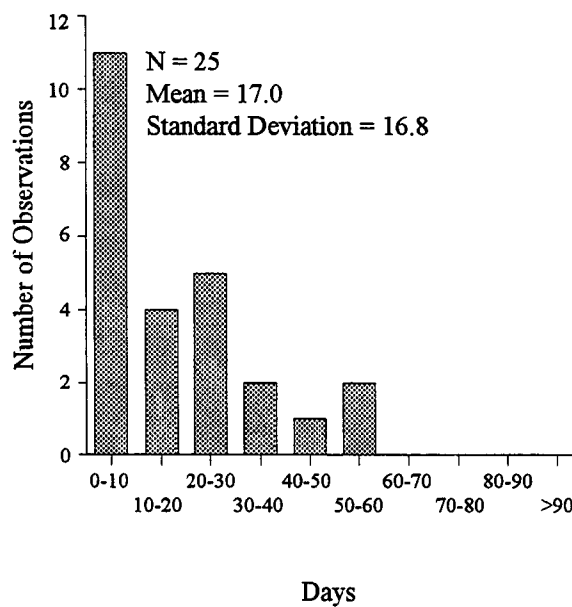
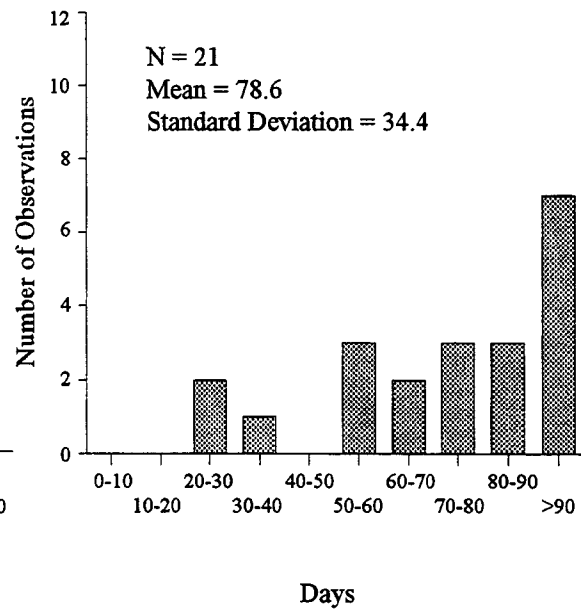
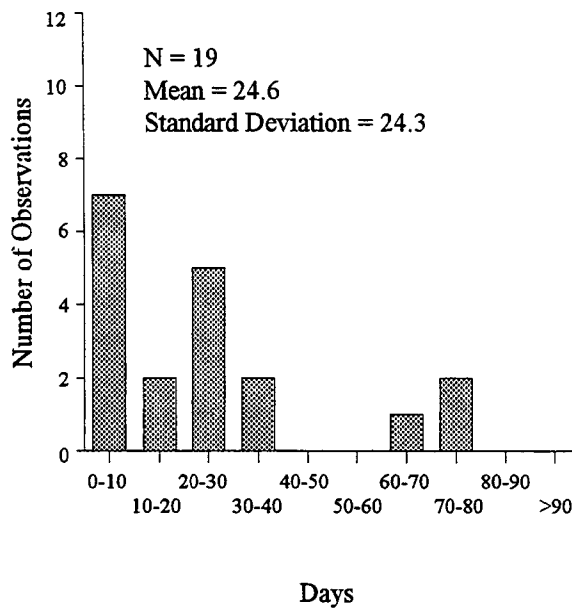


Figure 3.38. Distributions of Annual Average Number of Days Greater Than 90°F by Environmental Regions for GPS-2 Test Sections

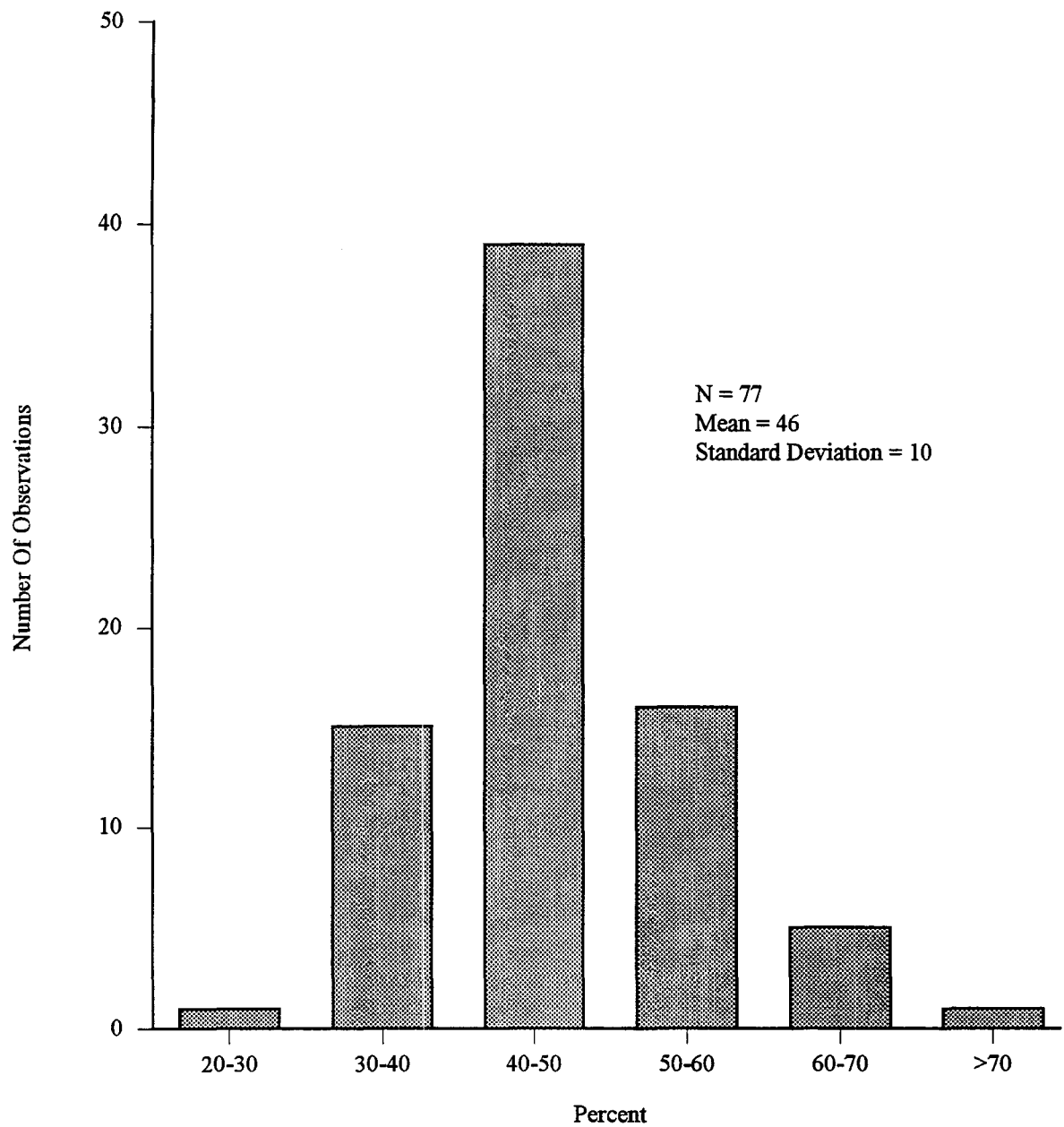
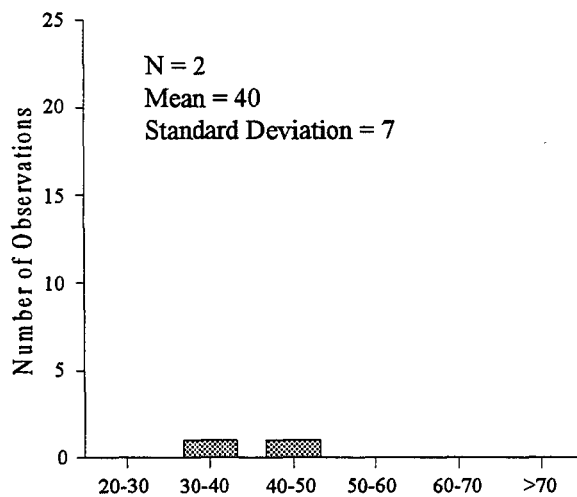
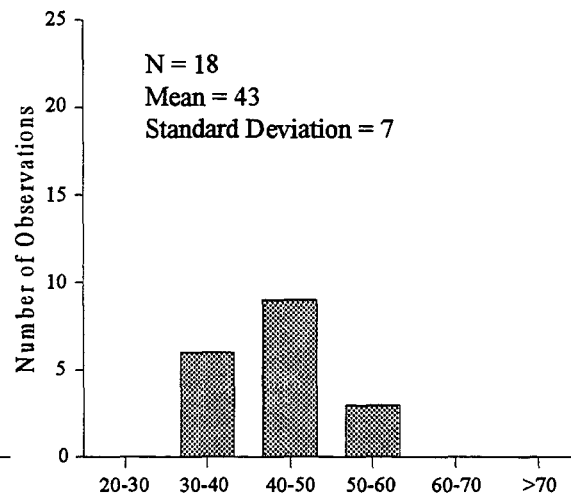


Figure 3.39. Distribution of Friction Number for GPS-2 Test Sections



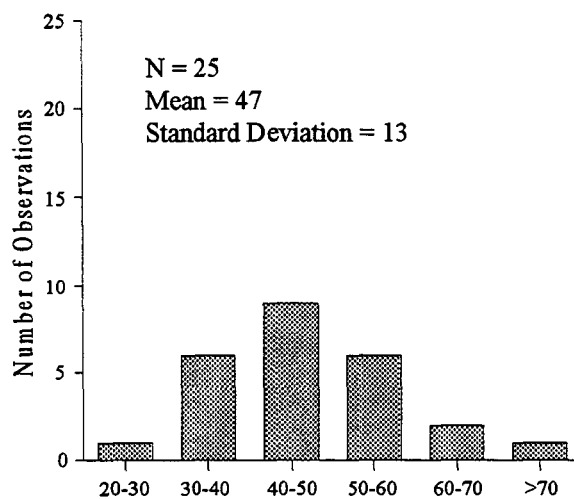
Percent

A. Dry-Freeze



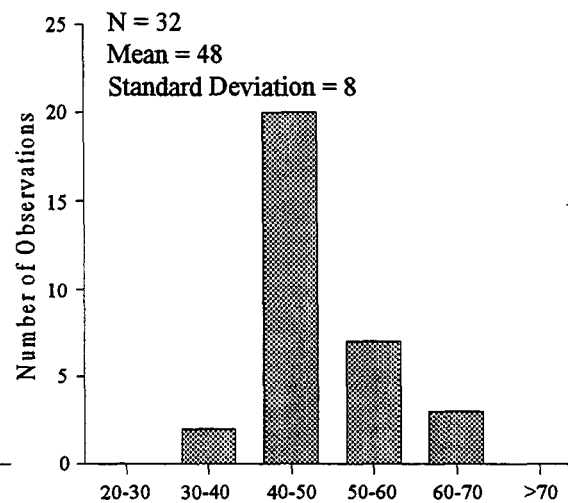
Percent

B. Dry-No Freeze



Percent

C. Wet-Freeze



Percent

D. Wet-No Freeze

Figure 3.40. Distributions of Friction Number by Environmental Regions for GPS-2 Test Sections

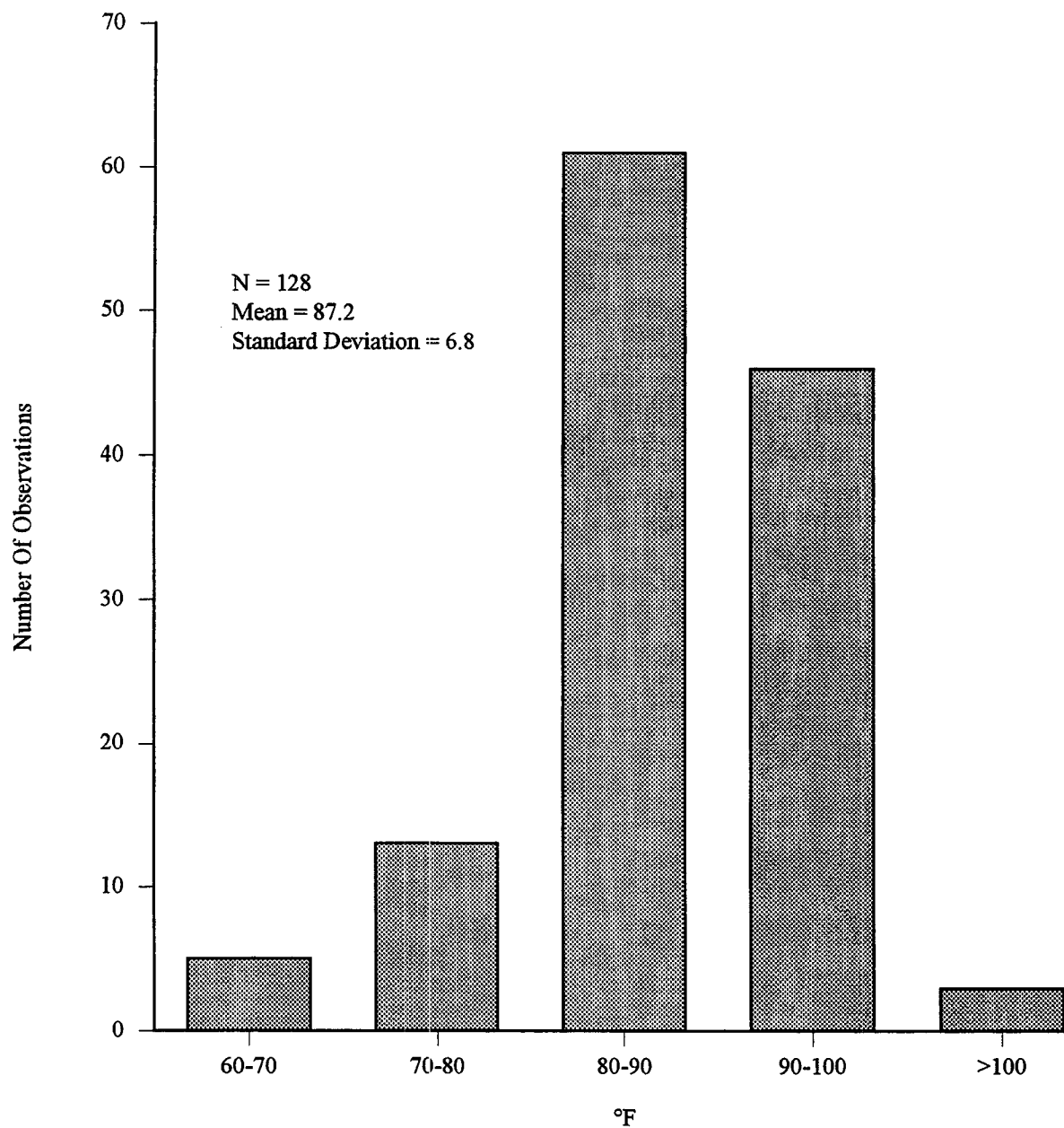
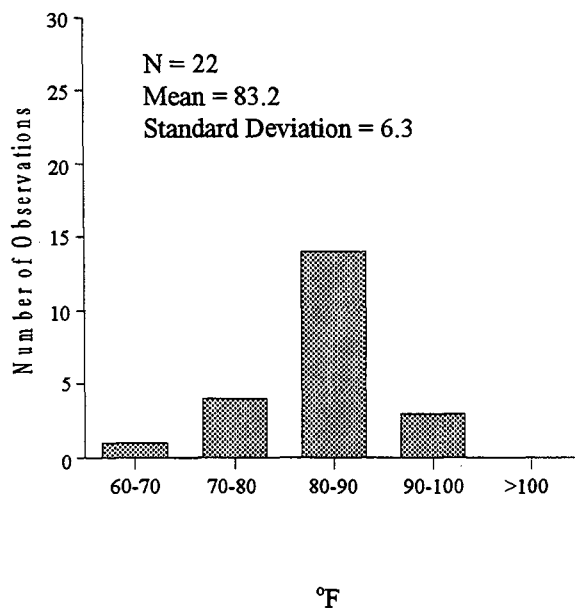
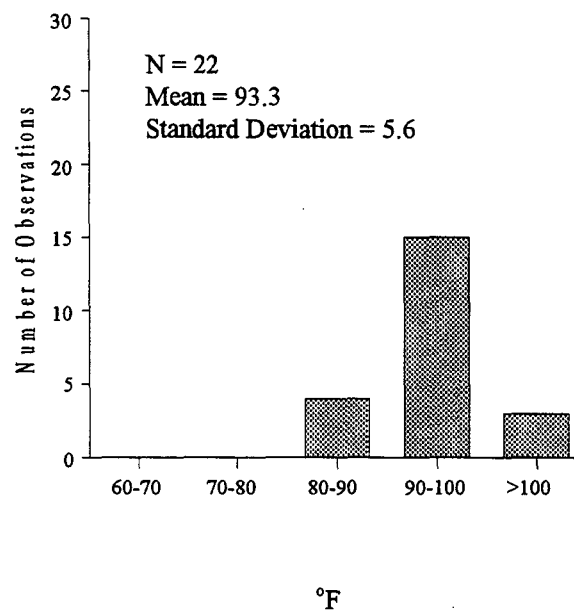


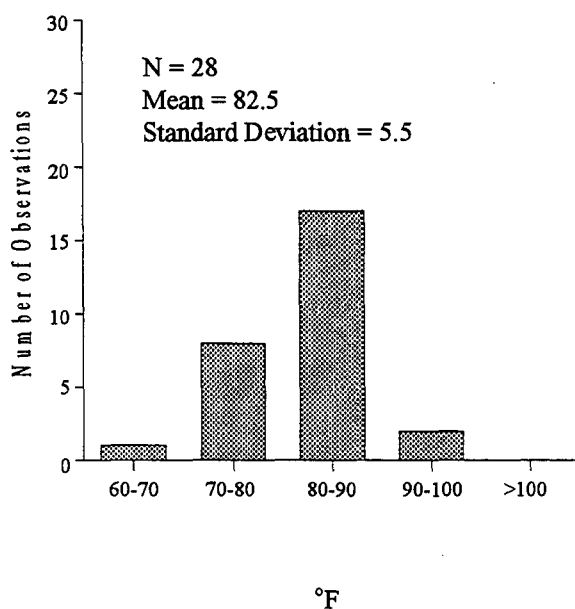
Figure 3.41. Distribution of Average Annual Maximum Temperature (for the Months of June, July and August) for GPS-2 Test Sections



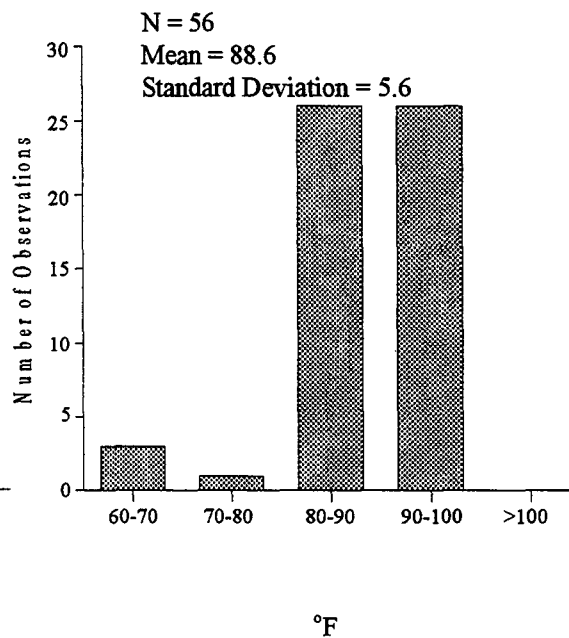
A. Dry-Freeze



B. Dry-No Freeze



C. Wet-Freeze



D. Wet-No Freeze

Figure 3.42. Distributions of Average Annual Maximum Temperature (for the Months of June, July and August) by Environmental Regions for GPS-2 Test Sections

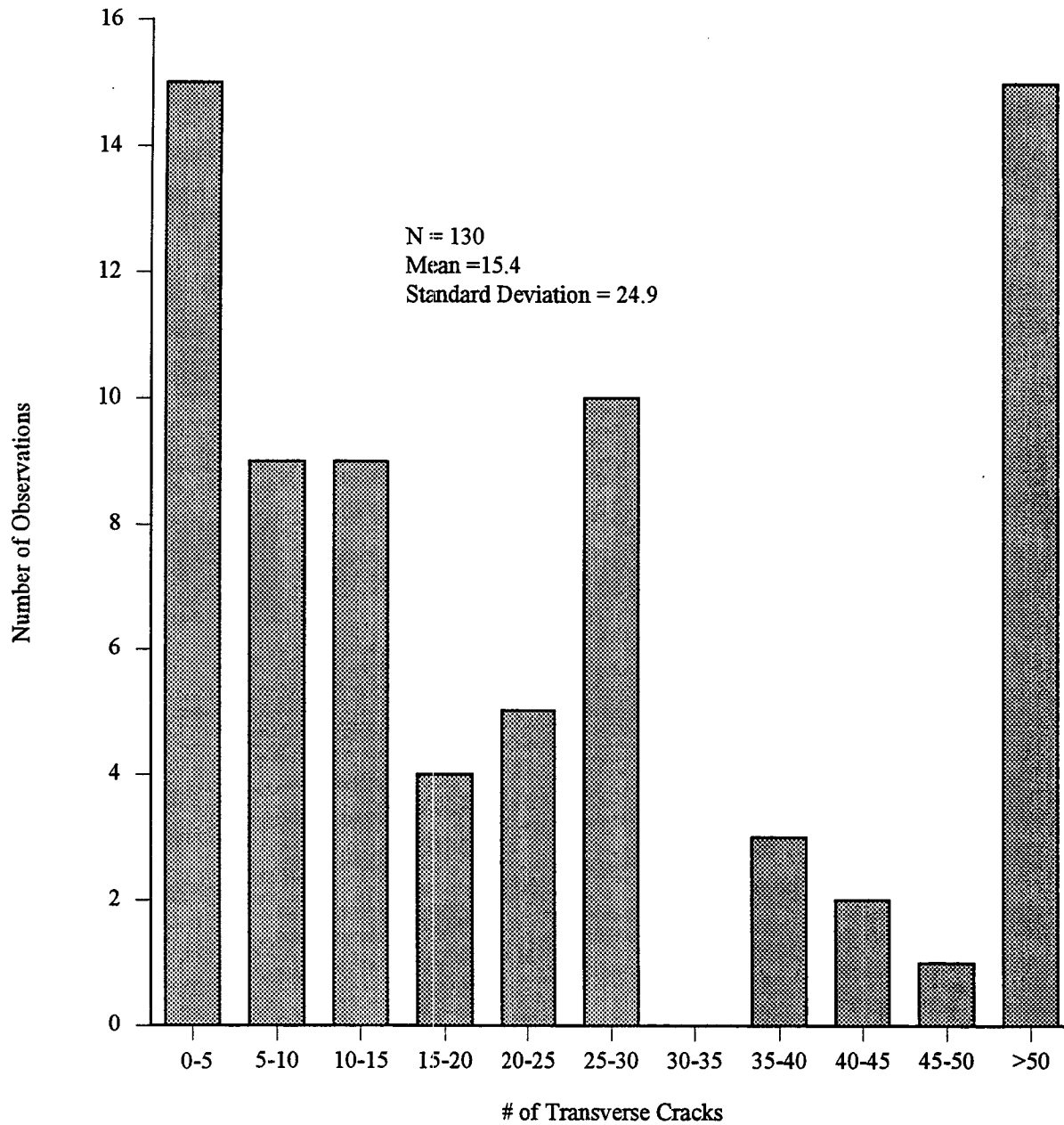
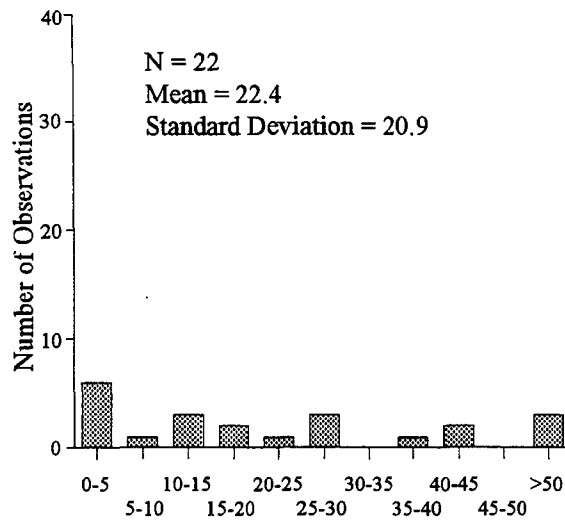
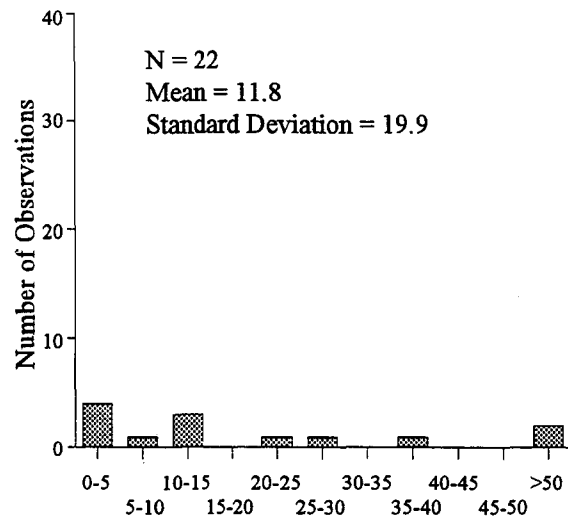


Figure 3.43. Distribution of the Number of Transverse Cracks for GPS-2 Test Sections



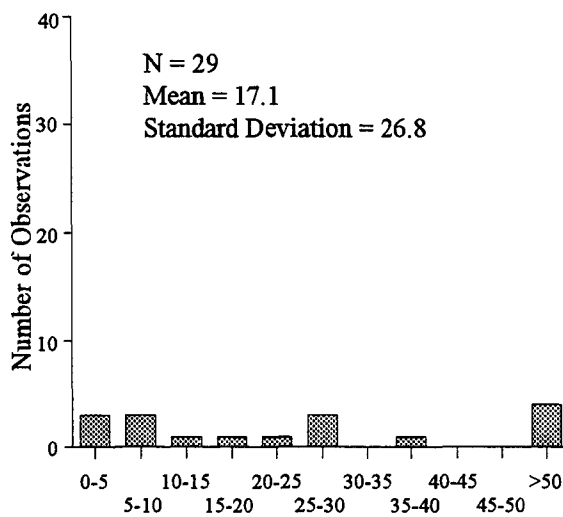
of Transverse Cracks

A. Dry-Freeze



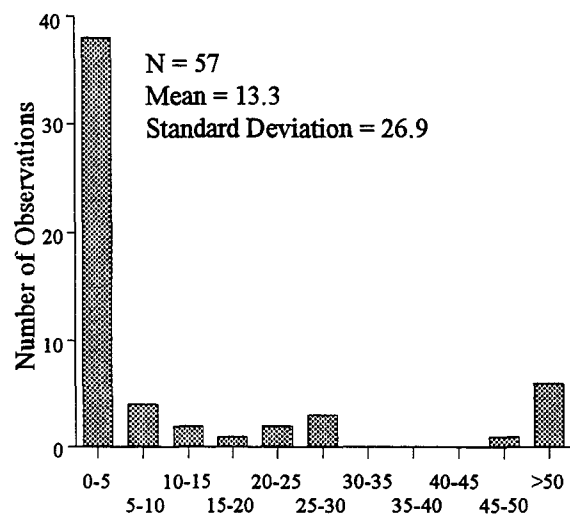
of Transverse Cracks

B. Dry-No Freeze



of Transverse Cracks

C. Wet-Freeze



of Transverse Cracks

D. Wet-No Freeze

Figure 3.44. Distributions of Number of Transverse Cracks by Environmental Regions for GPS-2 Test Sections

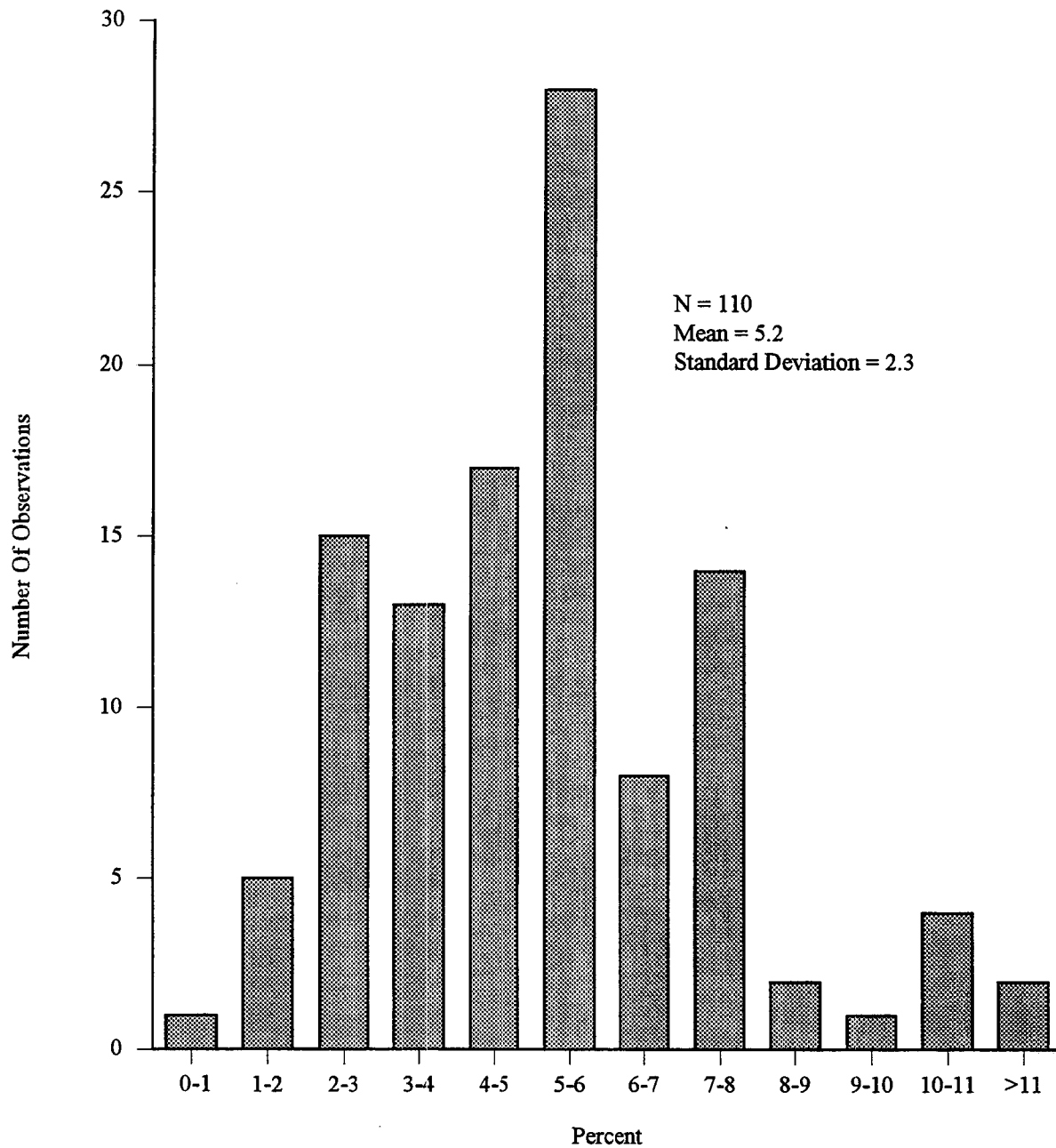


Figure 3.45. Distribution of HMAC Air Voids for GPS-2 Test Sections

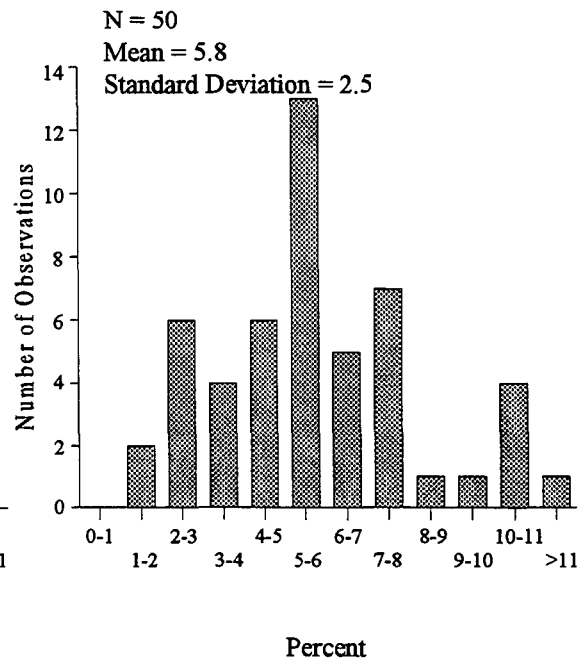
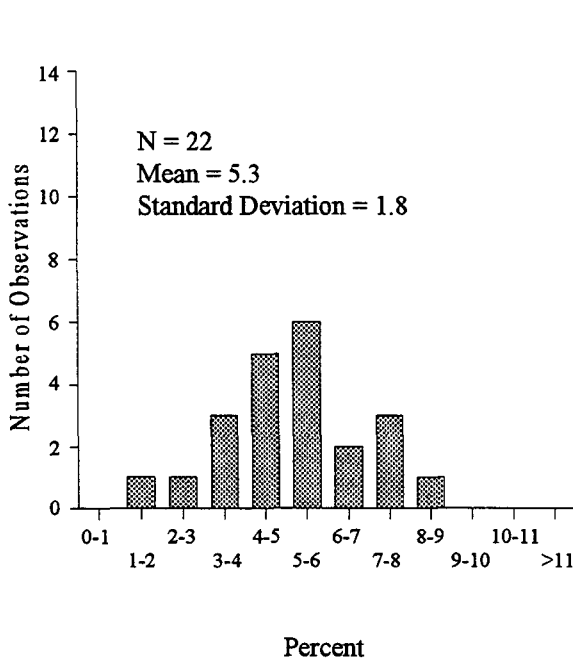
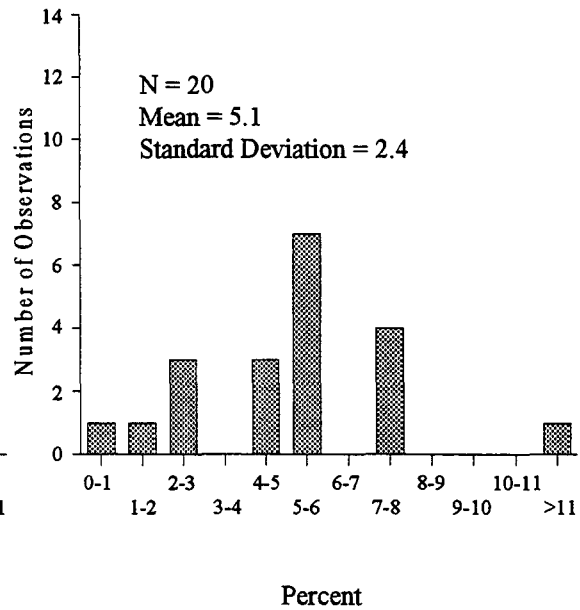
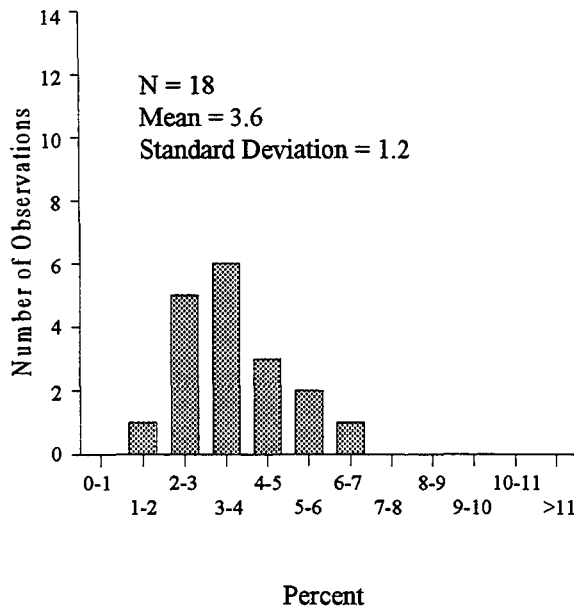


Figure 3.46. Distributions of HMAC Air Voids by Environmental Regions for GPS-2 Test Sections

Statistical Data for GPS-3 Test Sections

Statistical information on the 128 GPS-3 concrete pavement test sections for which data was available is provided in this chapter. The information includes statistical information on the key distress/roughness variables, and the significant variables of interest for the GPS-3 pavement sections. Specifically, they include tables that give information on the number of sections for each variable for which data was available, the mean, standard deviation, the minimum value, the median value, the maximum value, and range of the variable. A table that shows the correlations between the various significant variables, distresses, and roughness is also provided.

In addition, a number of plots are also provided that show the distribution of the various variables, distresses, and roughness. For each significant variable or distress/roughness a histogram, boxplot, probability density plot, and normal quantile-quantile plot are provided. For some of these variables or distresses/roughness, histograms that show their distribution by the four SHRP climatic regions, and scatter plots that show the relationship between the variable or distress/roughness and other selected variables or distresses/roughness, are also provided. For brevity, this latter information is not provided for all the variables or distresses/roughness.

Table 4.1 is a template that shows the number of test sections in each cell of the experiment design for the GPS-3 experiment. Environmental factors are defined in Figure 2.2 of Chapter 2. Other factors are summarized as follows:

Traffic Rate:	L - Less than 200 KESAL/Yr. H - Greater than or equal to 200 KESAL/Yr.
Dowels:	N - No Y - Yes
PCC Thickness:	L - Less than 9.5 in. (240 mm) H - Greater than 9.5 in. (240 mm)
Base Type:	Granular Stabilized

Table 4.4 relates the variable names used in the correlation table and statistical plots to variable descriptions.

Table 4.1 Number of Test Sections in Each Cell of the GPS-3 Sampling Template

Moisture			Wet								Dry							
Temperature			Freeze				No Freeze				Freeze				No Freeze			
Subgrade Type			F		C		F		C		F		C		F		C	
Traffic Rate			L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H
Base Type	PCC Thickness	Dowels	Number of JPCP Sections in the Data Set															
Granular	L	N	1	3	2	2		1	3	1	2		2	3				
		Y	2	3	2		2	1			1						1	
	H	N	1	2	1			1			4	1	2	4				1
		Y	1	2	1			2		1		1				1		
Stabilized	L	N	1	2	2		2	2	2	2	1		2	2	2	1	2	2
		Y	2	3			2	2	1	1		1						
	H	N						2		2	1	3	1	5		2	1	2
		Y	2	2		1	1	2	1	2		1					1	

Table 4.2 Statistical Values for Distress/Roughness Variables in the GPS-3 Data Set

Variable	Units	Sections With Distress	Mean	Standard Deviation	Low Value	Median Value	High Value	Range
Faulting	Inches	76	0.037	0.056	-0.03	0.01	0.28	0.31
Spalling:	No. Spalls	91	6.00	7.61	2	4	30	28
	Low Severity: Lin. Ft.	118	16.22	35.07	0.00	3.12	16.22	16.22
	No. Spalls	91	0.38	1.39	0	0	12	12
	Moderate Severity: Lin. Ft.	118	0.73	3.12	0.00	0.00	28.21	28.21
	No. Spalls	91	0.04	0.33	0	0	3	3
	High Severity: Lin. Ft.	118	0.12	1.08	0.00	0.00	11.49	11.49
Transverse Cracking:	Low Severity: No. Cracks	15	2.33	2.79	0	1	8	8
	Lin. Ft.	117	2.76	12.33	0.00	0.00	94.98	94.98
	Medium Severity: No. Cracks	15	2.07	4.23	0	1	15	15
	Lin. Ft.	117	2.46	14.18	0.00	0.00	112.30	112.3
	No. Cracks	15	2.07	5.15	0	0	20	20
	High Severity: Lin. Ft.	117	2.58	21.70	0.00	0.00	232.00	232.00
Roughness (IRI)	Inches/Mile	104	110.40	41.02	48.89	97.85	245.00	196.11

Table 4.3 Statistical Values of Interest for Significant Variables in the GPS-3 Data Set

Variable	Units	No. of Values	Mean Value	Standard Deviation	Low Value	Median Value	High Value	Range
PCC Thickness	Inches	114	9.50	1.27	6.30	9.34	14.28	7.98
Base Thickness	Inches	122	4.83	1.99	0.00	4.80	11.5	11.5
Subbase Thickness	Inches	122	4.28	9.10	0.00	0.00	72.00	72.00
KESALs per Year	No.	111	4,565	1860	34	229	1326	1292
Pavement Age	Years	111	11.04	6.05	1.24	9.96	29.82	28.58
Air Freeze-Thaw Cycles	No.	125	76.5	41.0	0	84	169	169
Freezing Index	Degree Days	125	651	704.2	0	478	3396	3396
No. of Days Temp. > 90°F	No.	125	38	34.3	0	30	176	176
No. of Days Temp. < 32°F	No.	125	99	60.2	0	116	203	203
Average Min. Temp. by Month	°F	121	19.41	14.99	-10.04	17.47	65.19	75.23
Average Max. Temp. by Month	°F	121	88.54	5.69	72.74	89.39	103.10	33.36
Average Monthly Precipitation	Inches	125	2.67	1.27	0.36	2.78	5.70	5.34
Average Yearly Precipitation	Inches	125	32.07	15.19	17.10	39.50	67.90	50.80
Wet Days in Year	No.	125	113.6	38.1	23	123	219	196
Dowel Diameter	Inches	47	1.15	0.22	0.25	1.25	1.50	1.25
Dowel Length	Inches	43	18.21	3.47	8.00	18.00	30.00	22.00
Dowel Spacing	Inches	37	6.36	1.47	4.5	6.0	12.0	7.5
Joint Spacing	Feet	125	16.74	3.65	11.4	15.5	30.0	18.6
Subgrade Soil Passing #200	Percent	118	40.20	26.76	1.30	37.55	98.40	97.10

Variable	Units	No. of Values	Mean Value	Standard Deviation	Low Value	Median Value	High Value	Range
Backcalculated Static k-value	pci	114	161.90	94.0	33.11	139.60	534.90	501.79
PCC Elastic Modulus	x10 ⁶ , psi	114	4.50	0.84	2.82	4.39	6.80	3.98
PCC 28-day Flexural Strength	psi	107	721.4	109.95	542	695	1040	498
PCC Compressive Strength	psi	104	7508	1321	4730	7425	12360	7630
PCC Indirect Tensile Strength	psi	114	619.6	122.05	423	595	993	570

Table 4.4 Nomenclature Used for Correlation Table and Statistical Plots

Variable	Description of Variable
FAULT	Faulting, inches
TSPALLNO	Total number of spalled joints (all severities)
SPALL.H.NO	Number of high severity spalled joints
SPALL.M.NO	Number of low severity spalled joints
SPALL.L.NO	Number of low severity spalled joints
TSPALLFT	Total measured joint spalling (all severities) in linear feet
SPALL.H.FT	Measured high severity spalling in linear feet
SPALL.M.FT	Measured medium severity spalling in linear feet
SPALL.L.FT	Measured low severity spalling in linear feet
TCRACKNO	Total number of transverse cracks (all severities)
TCRACK.H.NO	Number of high severity transverse cracks
TCRACK.M.NO	Number of medium severity transverse cracks
TCRACK.L.NO	Number of low severity transverse cracks
TCRACKFT	Total measured transverse cracking (all severities) in linear feet
TCRACK.H.FT	Measured high severity transverse cracking in linear feet
TCRACK.M.FT	Measured medium severity transverse cracking in linear feet
TCRACK.L.FT	Measured low severity transverse cracking in linear feet
AVE.IRI or IRI	Measured average IRI value, inches/mile
AVE.SV	Measured average slope variance
THICK	Measured PCC layer thickness, inches
BASETHK	Measured base thickness, inches
SBASETHK	Measured subbase thickness, inches
YRL.KESAL or YRKESAL	Cumulative 18-kip ESALs per year, thousands
AGE	Pavement age, years
FT	Average number of air freeze-thaw cycles
FI	Freezing index, degree days
DAYS90	Number of days with temperature greater than 90°F
DAYS32	Number of days with temperature lower than 32°F
MAXTEMP	Average monthly maximum temperature, °F

Table 4.4 Nomenclature Used for Correlation Table and Statistical Plots

MINTEMP	Average monthly minimum temperature, °F
YRL.PRECIP or YRPRECIP	Average precipitation by year, inches
PRECIP	Average precipitation by month, inches
DAYSWET	Average number of wet days
DOWDIA	Dowel diameter, inches
JTSPACE	Joint spacing, feet
PM200	Subgrade soil passing the #200 sieve, percent by weight
KSTATIS	Backcalculated modulus of subgrade reaction, psi/inch
EPCC	Measured PCC layer elastic modulus, psi
FLEX28	PCC layer 28-day flexural strength, psi
COMPSTR	PCC layer compressive strength, psi
TENSTR	PCC layer indirect (split) tensile strength, psi

Table 4.5 Correlation Matrix for Significant Variables in GPS-3 Data Set

	FAULT	TSPALLNO	TSPALLFT	TCRACKNO	TCRACKFT	IRI	THICK	BASETHK	SBASETHK	KSTATIC	YRKESAL	FT
FAULT	1.000	-0.629	-0.541	-0.213	-0.199	0.974	0.144	-0.358	-0.439	-0.442	0.108	-0.213
TSPALLNO	-0.629	1.000	0.883	-0.449	-0.428	-0.636	-0.501	-0.020	0.098	0.441	-0.622	0.711
TSPALLFT	-0.541	0.883	1.000	-0.358	-0.337	-0.485	-0.349	-0.227	-0.035	0.607	-0.513	0.827
TCRACKNO	-0.213	-0.449	-0.358	1.000	0.998	-0.240	0.759	0.071	-0.231	0.425	0.821	-0.645
TCRACKFT	-0.199	-0.428	-0.337	0.998	1.000	-0.230	0.772	0.046	-0.278	0.462	0.823	-0.636
IRI	0.974	-0.636	-0.485	-0.240	-0.230	1.000	0.178	-0.265	-0.321	-0.473	0.148	-0.127
THICK	0.144	-0.501	-0.349	0.759	0.772	0.178	1.000	0.175	-0.295	0.251	0.958	-0.346
BASETHK	-0.358	-0.020	-0.227	0.071	0.046	-0.265	0.175	1.000	0.810	-0.452	0.326	-0.126
SBASETHK	-0.439	0.098	-0.035	-0.231	-0.278	-0.321	-0.295	0.810	1.000	-0.563	-0.119	0.090
KSTATIC	-0.442	0.441	0.607	0.425	0.462	-0.473	0.251	-0.452	-0.563	1.000	0.104	0.184
YRKESAL	0.108	-0.622	-0.513	0.821	0.823	0.148	0.958	0.326	-0.119	0.104	1.000	-0.542
FT	-0.213	0.711	0.827	-0.645	-0.636	-0.127	-0.346	-0.126	0.090	0.184	-0.542	1.000
FI	-0.136	0.019	0.036	-0.446	-0.495	0.007	-0.275	0.545	0.833	-0.638	-0.206	0.402
MAXTEMP	-0.262	0.287	0.216	0.429	0.474	-0.382	0.130	-0.347	-0.587	0.761	0.091	-0.285
MINTEMP	0.110	-0.333	-0.383	0.689	0.716	-0.027	0.382	-0.318	-0.611	0.425	0.429	-0.758
DAYS90	-0.324	-0.010	-0.089	0.770	0.794	-0.451	0.392	-0.177	-0.473	0.660	0.407	-0.551
DAYS32	-0.124	0.406	0.508	-0.663	-0.684	0.007	-0.335	0.175	0.462	-0.258	-0.436	0.861
YRPRECIP	0.325	-0.893	-0.804	0.486	0.449	0.338	0.263	0.091	0.139	-0.413	0.469	-0.787
PRECIP	0.326	-0.894	-0.803	0.486	0.449	0.340	0.264	0.090	0.138	-0.413	0.470	-0.786
JTSPACE	-0.005	-0.457	-0.399	0.694	0.701	-0.032	0.319	-0.059	-0.206	0.255	0.480	-0.807
PM200	0.856	-0.343	-0.302	-0.335	-0.309	0.868	0.264	-0.103	-0.340	-0.377	0.154	0.101
EPCC	0.538	-0.289	-0.061	-0.225	-0.220	0.672	0.415	0.110	-0.017	-0.291	0.299	0.375
DAYSWET	0.587	-0.884	-0.654	0.166	0.132	0.672	0.271	0.015	0.124	-0.542	0.385	-0.390

Table 4.5 Correlation Matrix for Significant Variables in GPS-3 Data Set

	FI	MAXTEMP	MINTEMP	DAYS90	DAYS32	YRPRECIP	PRECIP	JTSPACE	PM200	EPCC	DAYSWET
FAULT	-0.136	-0.262	0.110	-0.324	-0.124	0.325	0.326	-0.005	0.856	0.538	0.587
TSPALLNO	0.019	0.287	-0.333	-0.010	0.406	-0.893	-0.894	-0.457	-0.343	-0.289	-0.884
TSPALLFT	0.036	0.216	-0.383	-0.089	0.508	-0.804	-0.803	-0.399	-0.302	-0.061	-0.654
TCRACKNO	-0.446	0.429	0.689	0.770	-0.663	0.486	0.486	0.694	-0.335	-0.225	0.166
TCRACKFT	-0.495	0.474	0.716	0.794	-0.684	0.449	0.449	0.701	-0.309	-0.220	0.132
IRI	0.007	-0.382	-0.027	-0.451	0.007	0.338	0.340	-0.032	0.868	0.672	0.672
THICK	-0.275	0.130	0.382	0.392	-0.335	0.263	0.264	0.319	0.264	0.415	0.271
BASETHK	0.545	-0.347	-0.318	-0.177	0.175	0.091	0.090	-0.059	-0.103	0.110	0.015
SBASETHK	0.833	-0.587	-0.611	-0.473	0.462	0.139	0.138	-0.206	-0.340	-0.017	0.124
KSTATIC	-0.638	0.761	0.425	0.660	-0.258	-0.413	-0.413	0.255	-0.377	-0.291	-0.542
YRKESAL	-0.206	0.091	0.429	0.407	-0.436	0.469	0.470	0.480	0.154	0.299	0.385
FT	0.402	-0.285	-0.758	-0.551	0.861	-0.787	-0.786	-0.807	0.101	0.375	-0.390
FI	1.000	-0.906	-0.892	-0.814	0.801	0.063	0.063	-0.565	-0.019	0.391	0.331
MAXTEMP	-0.906	1.000	0.797	0.873	-0.718	-0.230	-0.231	0.564	-0.303	-0.603	-0.591
MINTEMP	-0.892	0.797	1.000	0.885	-0.978	0.341	0.340	0.810	-0.128	-0.496	-0.062
DAYS90	-0.814	0.873	0.885	1.000	-0.830	0.086	0.085	0.667	-0.429	-0.627	-0.371
DAYS32	0.801	-0.718	-0.978	-0.830	1.000	-0.449	-0.447	-0.854	0.135	0.524	-0.012
YRPRECIP	0.063	-0.230	0.341	0.086	-0.449	1.000	1.000	0.620	-0.070	-0.054	0.834
PRECIP	0.063	-0.231	0.340	0.085	-0.447	1.000	1.000	0.620	-0.068	-0.051	0.836
JTSPACE	-0.565	0.564	0.810	0.667	-0.854	0.620	0.620	1.000	-0.307	-0.439	0.238
PM200	-0.019	-0.303	-0.128	-0.429	0.135	-0.070	-0.068	-0.307	1.000	0.773	0.311
EPCC	0.391	-0.603	-0.496	-0.627	0.524	-0.054	-0.051	-0.439	0.773	1.000	0.457
DAYSWET	0.331	-0.591	-0.062	-0.371	-0.012	0.834	0.836	0.238	0.311	0.457	1.000

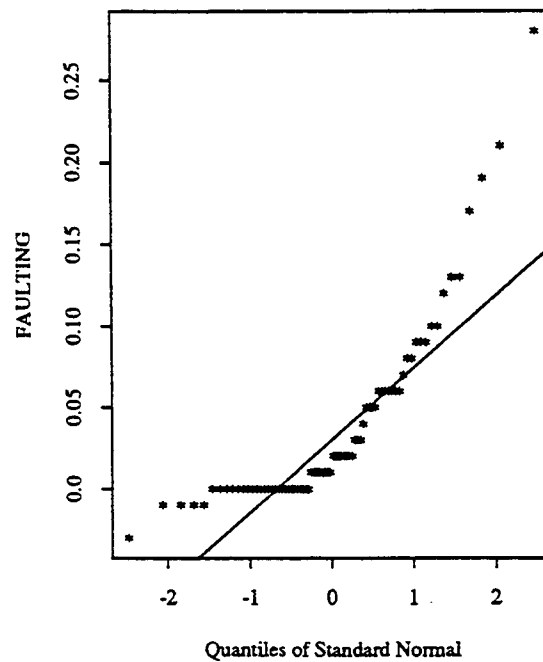
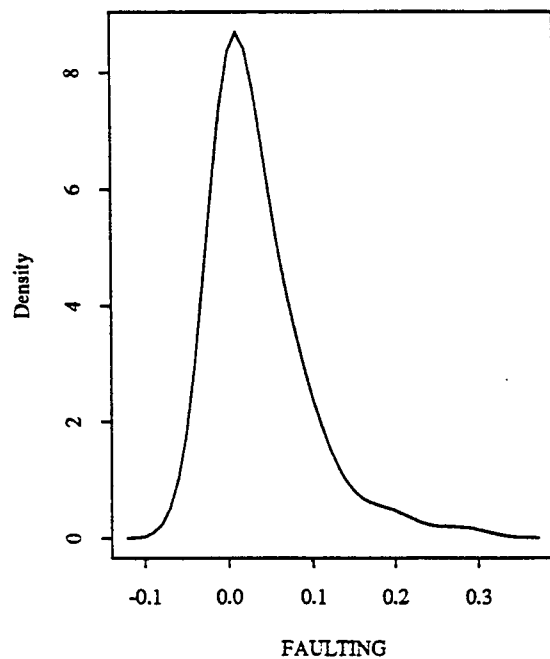
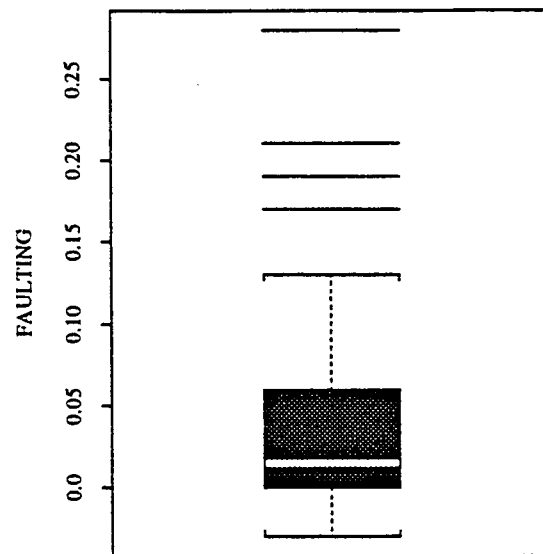
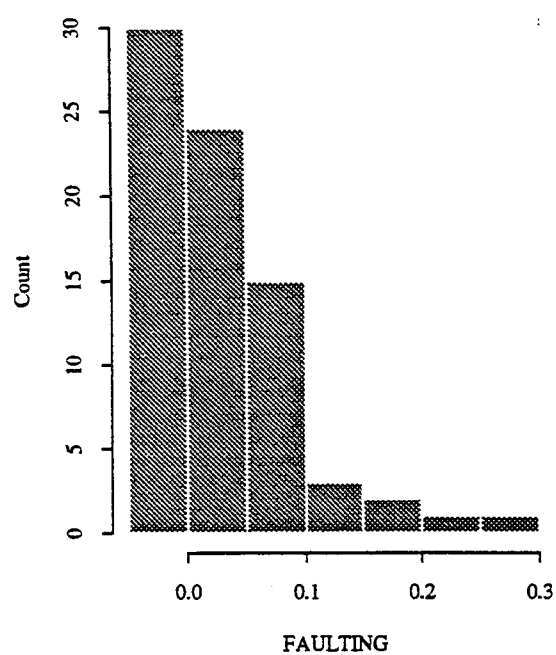


Figure 4.1 Statistical Distribution of Faulting for GPS-3 Sections

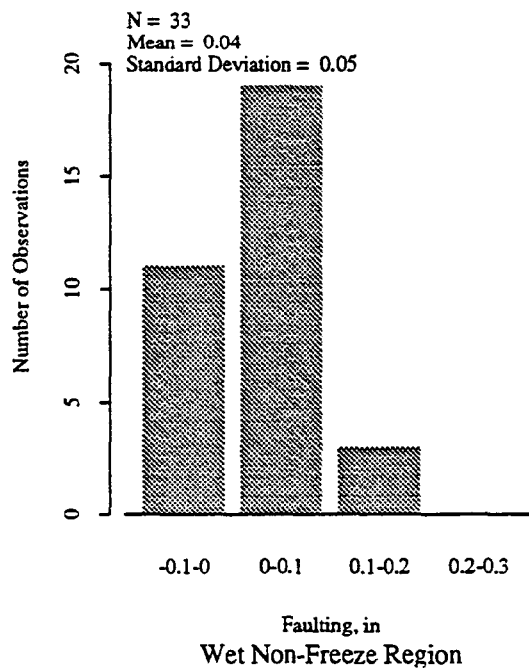
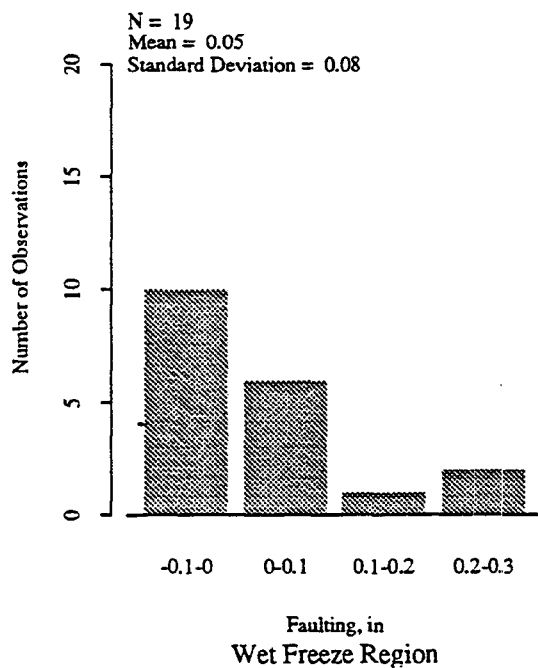
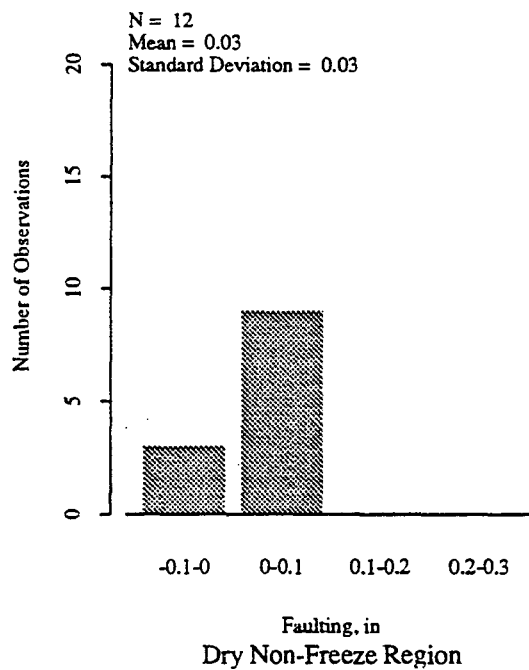
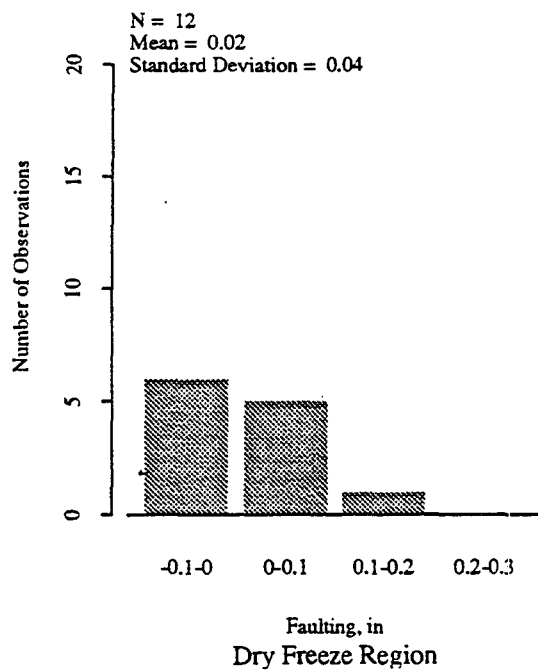


Figure 4.2 Distribution of Faulting by Environmental Regions for GPS-3 Sections

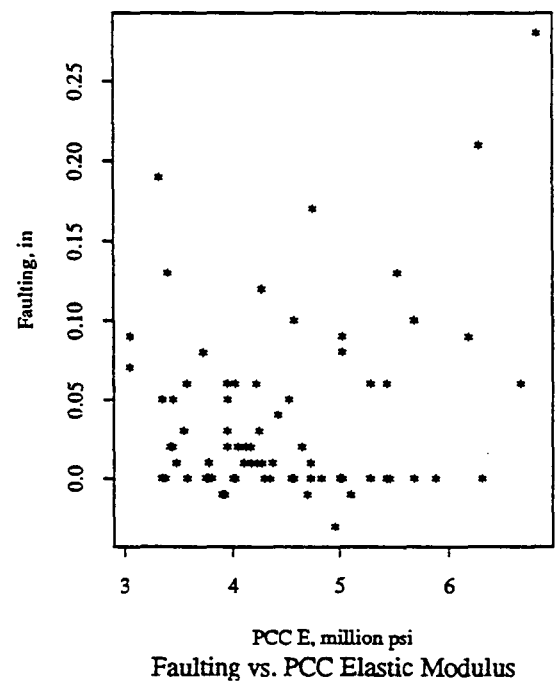
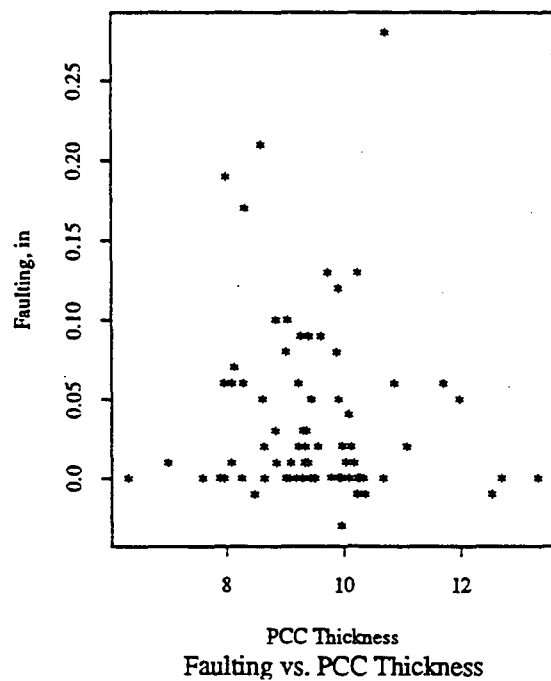
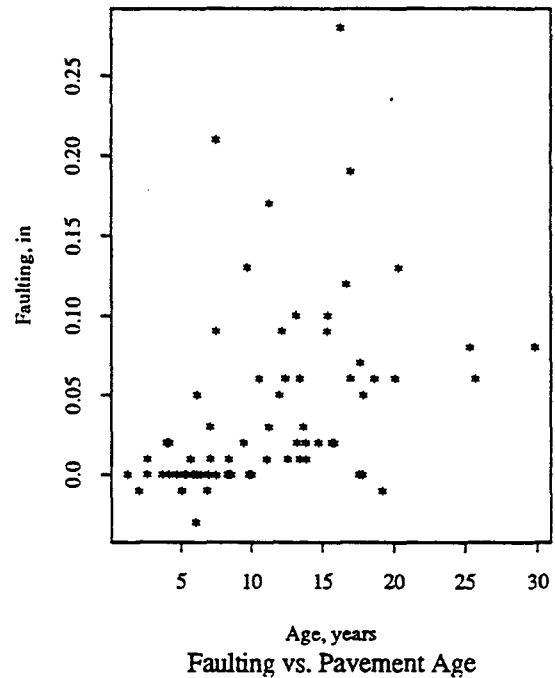
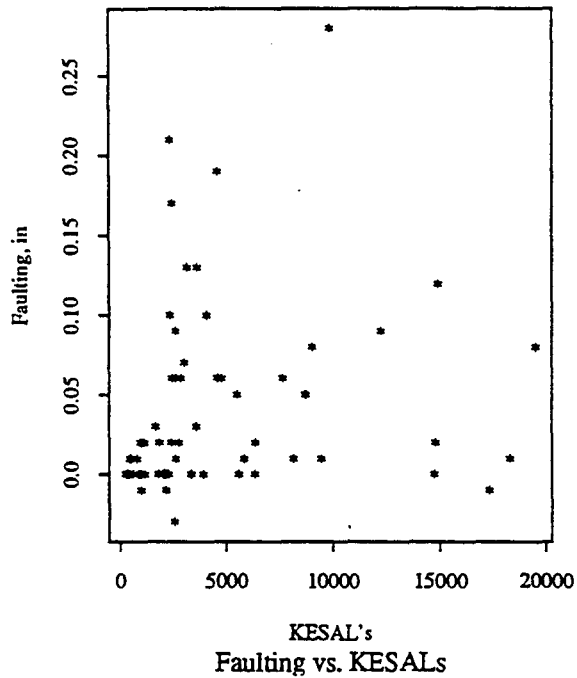


Figure 4.3 Faulting Scatter Plot for GPS-3 Sections

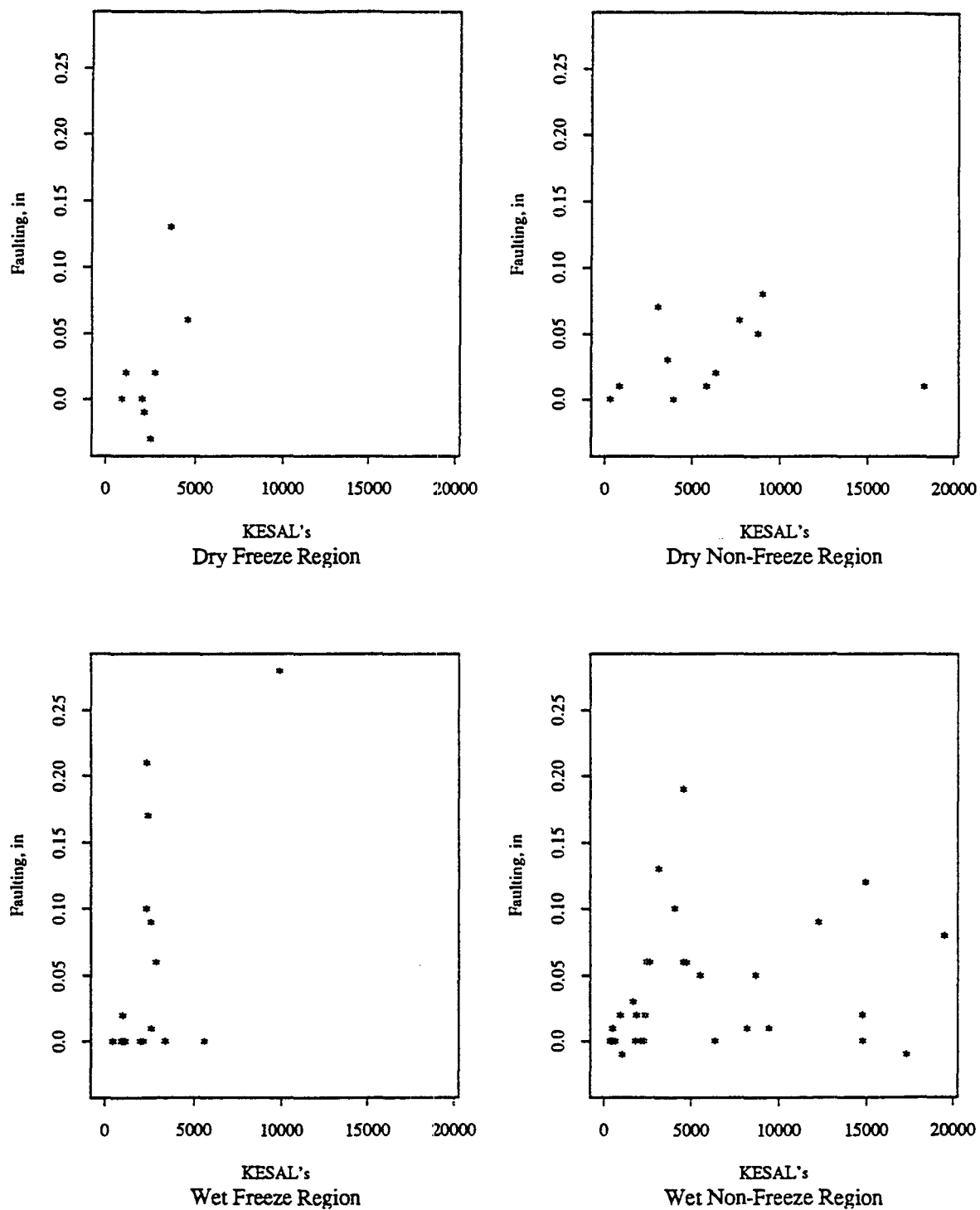


Figure 4.4 Faulting vs. KESALs Scatter Plots for GPS-3 Sections

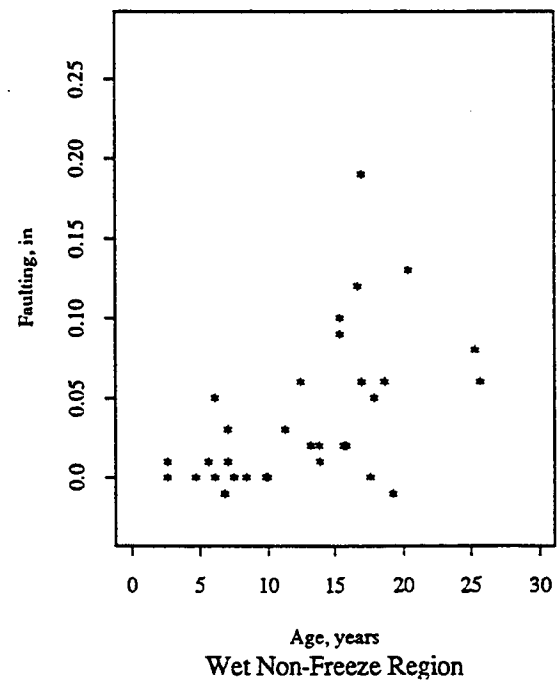
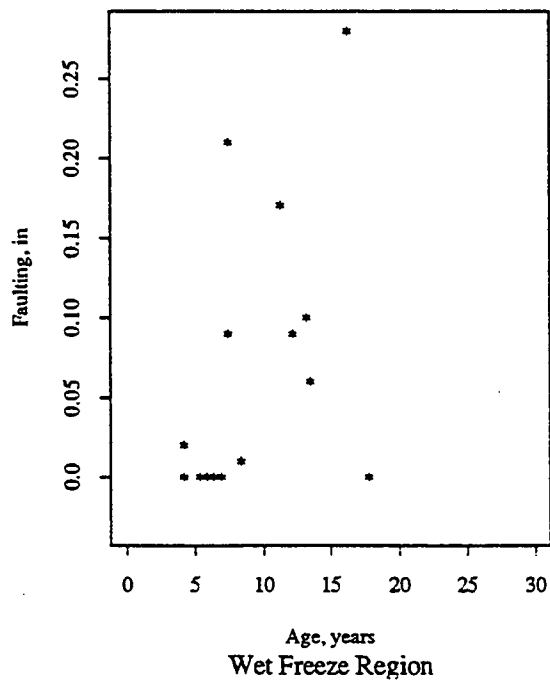
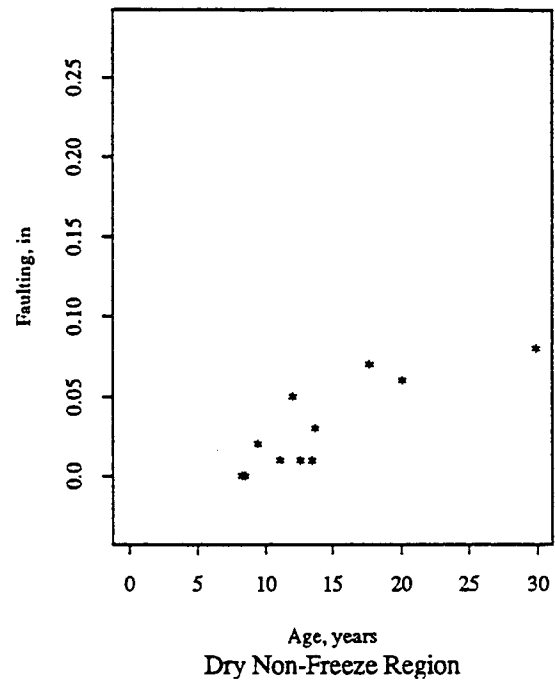
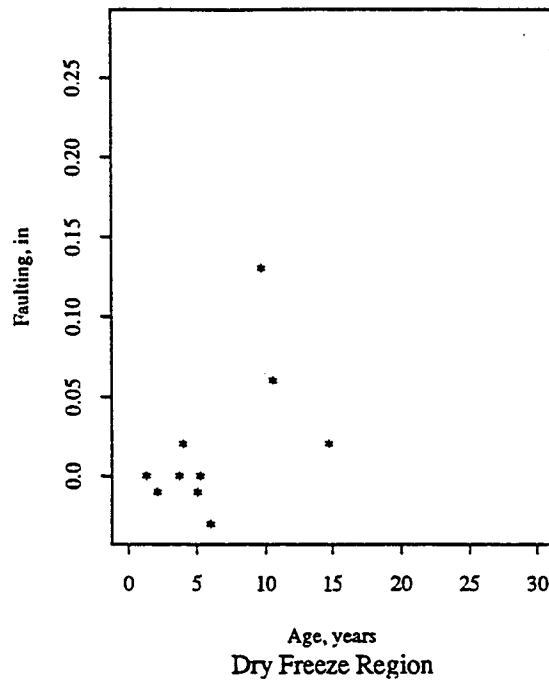


Figure 4.5 Faulting vs. Pavement Age Scatter Plots for GPS-3 Sections

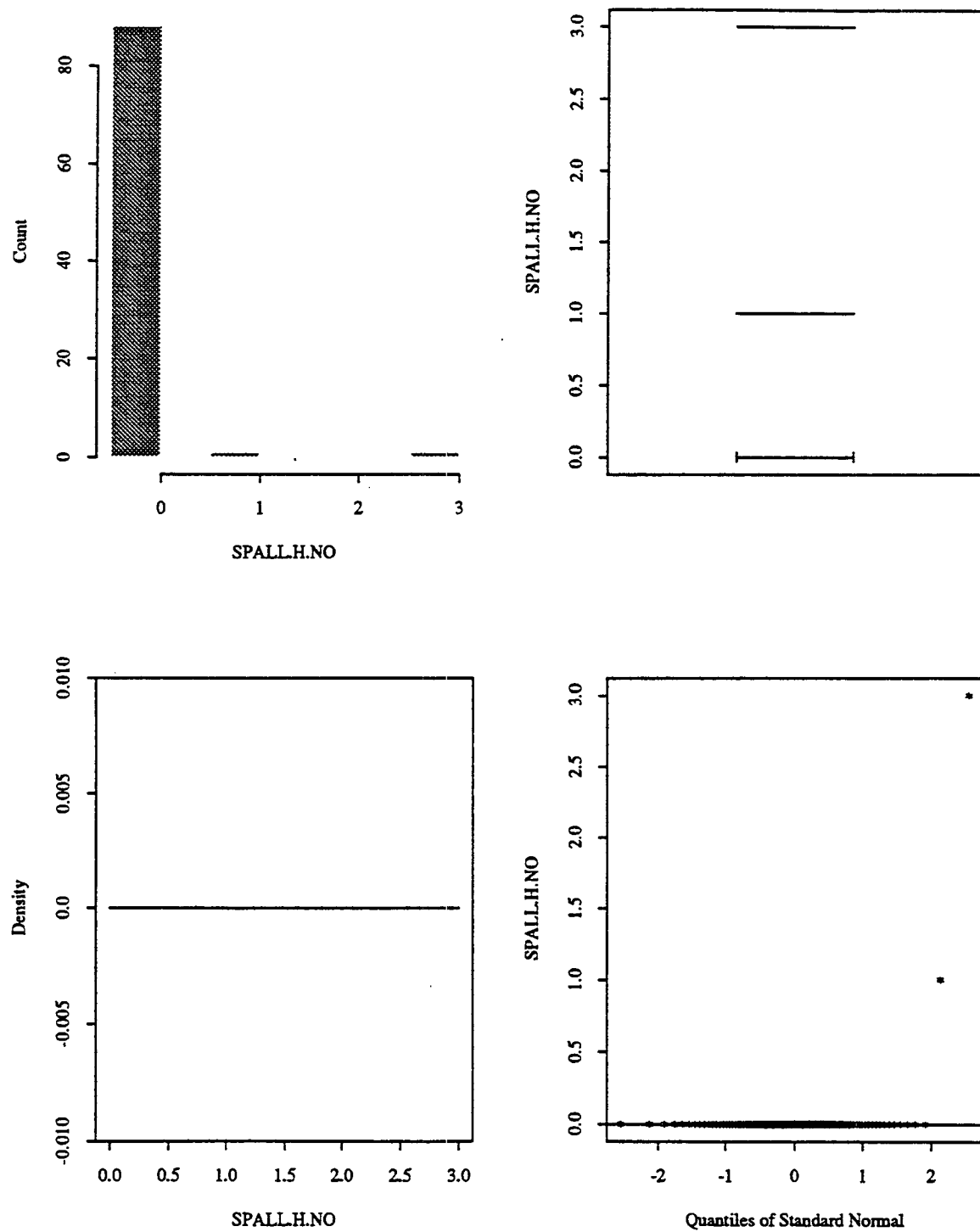


Figure 4.6 Statistical Distribution of High Severity Spalling for GPS-3 Sections

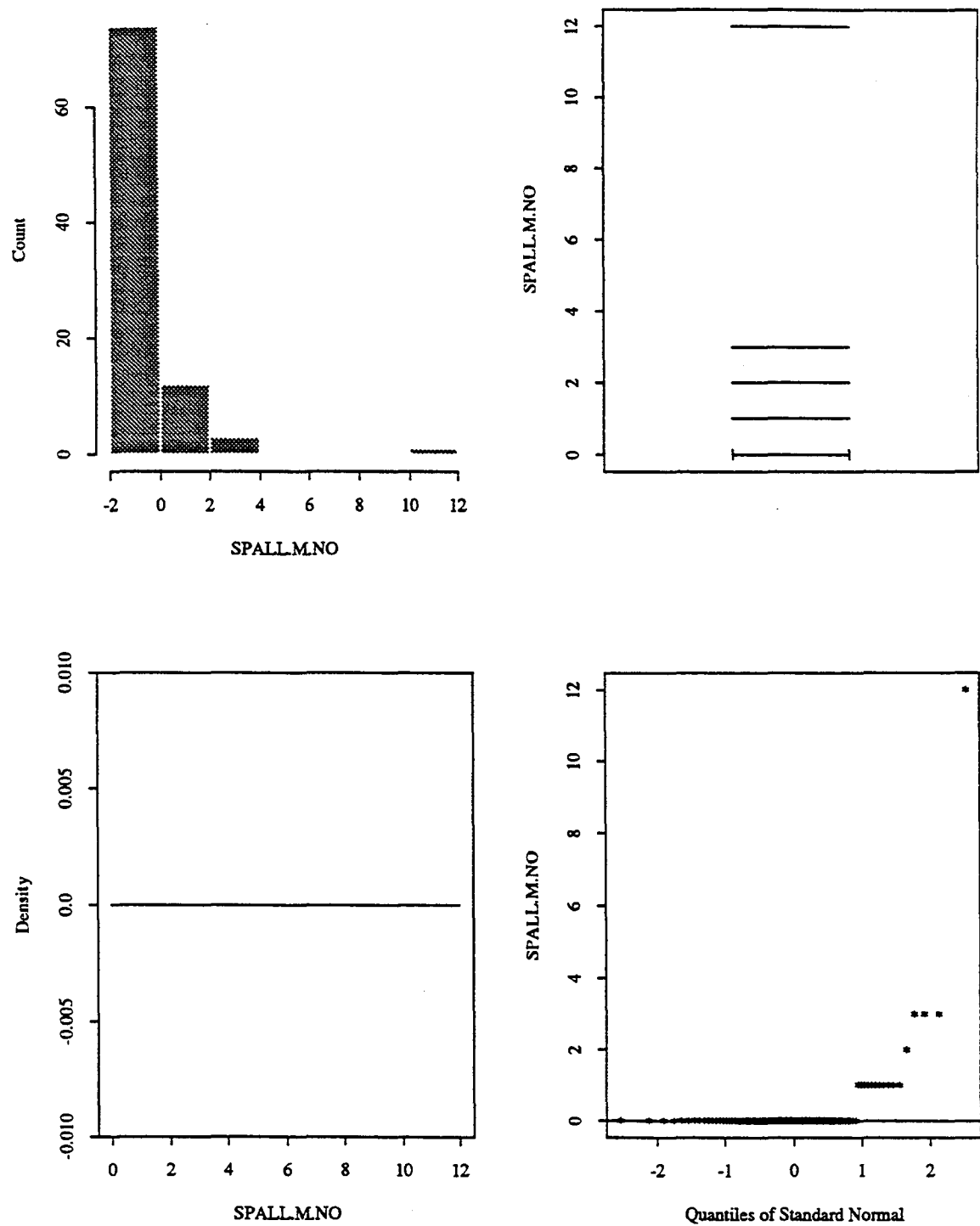


Figure 4.7 Statistical Distribution of Medium Severity Spalling for GPS-3 Sections

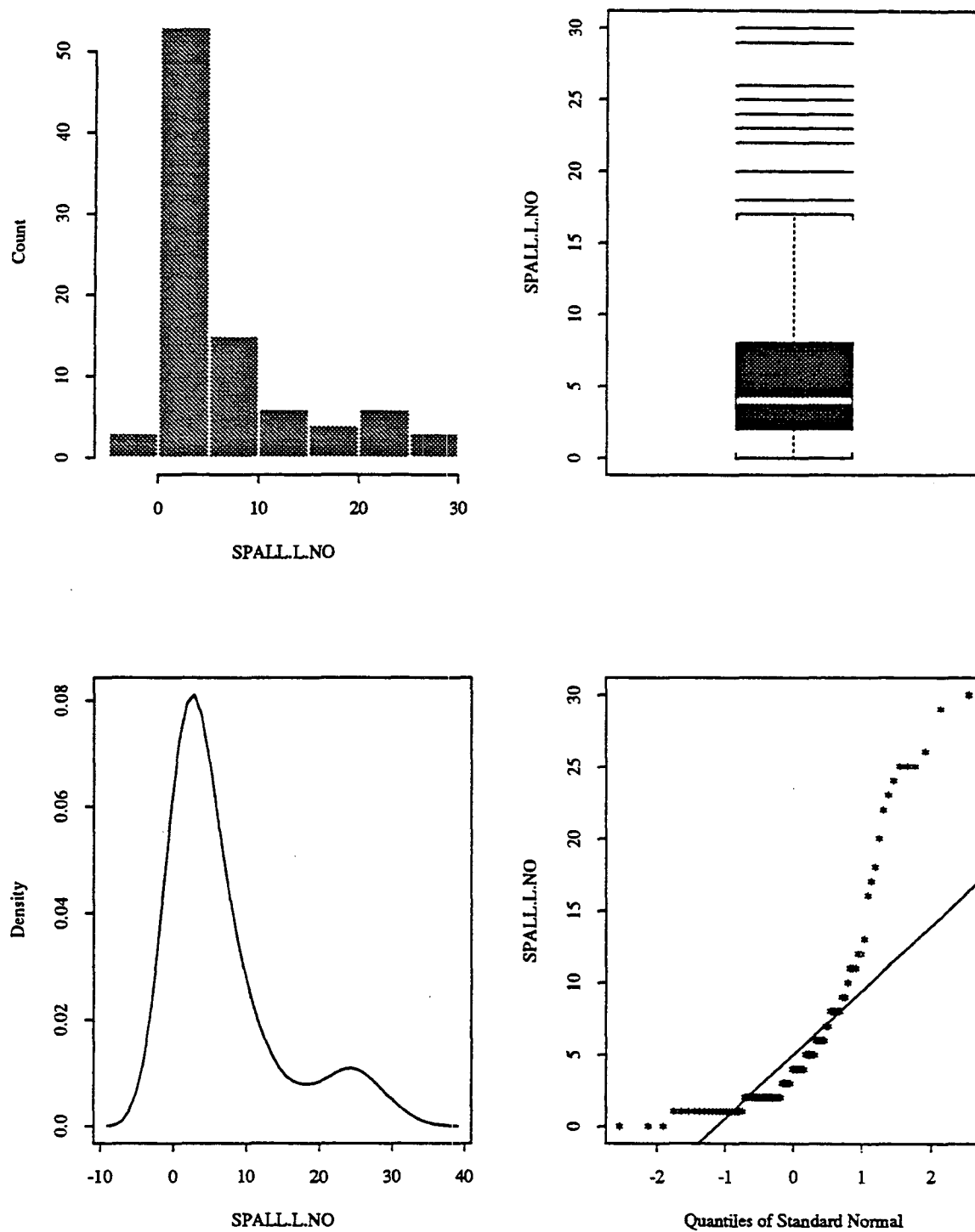


Figure 4.8 Statistical Distribution of Low Severity Spalling for GPS-3 Sections

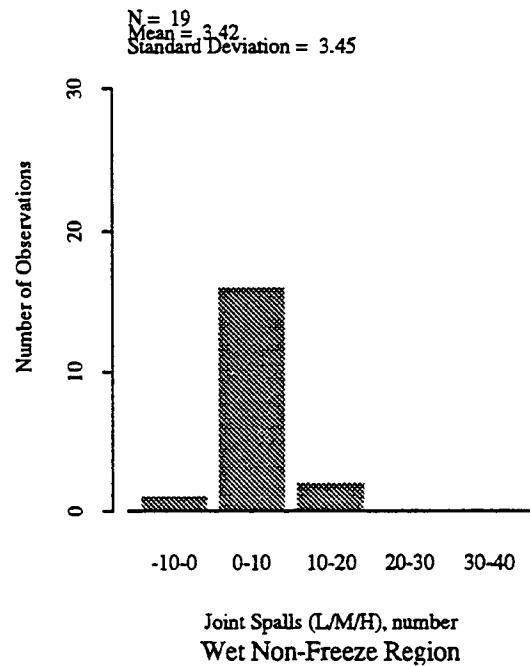
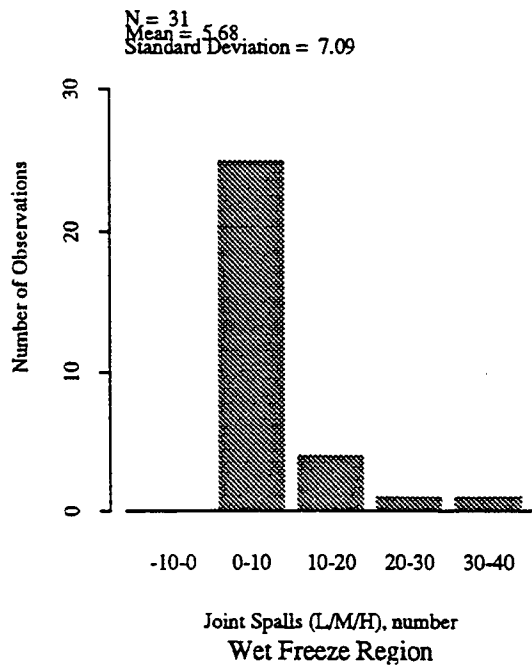
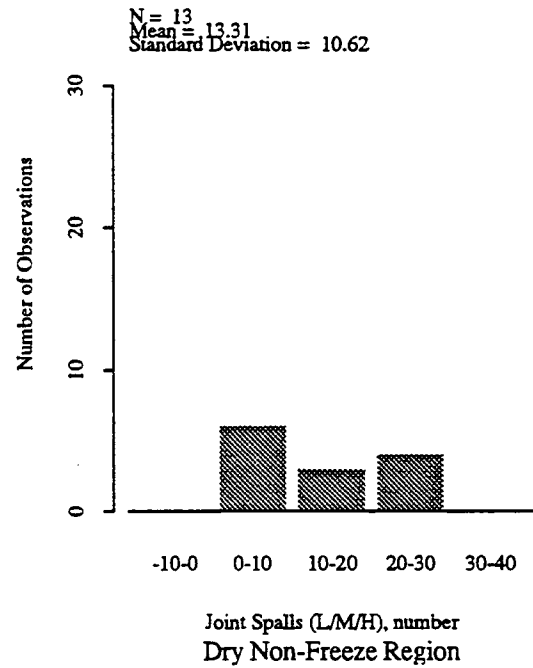
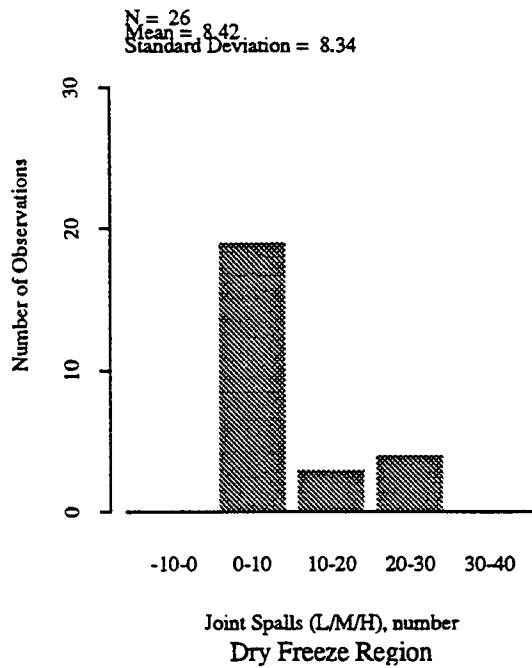


Figure 4.9 Distribution of Joint Spalling by Environmental Regions for GPS-3 Sections

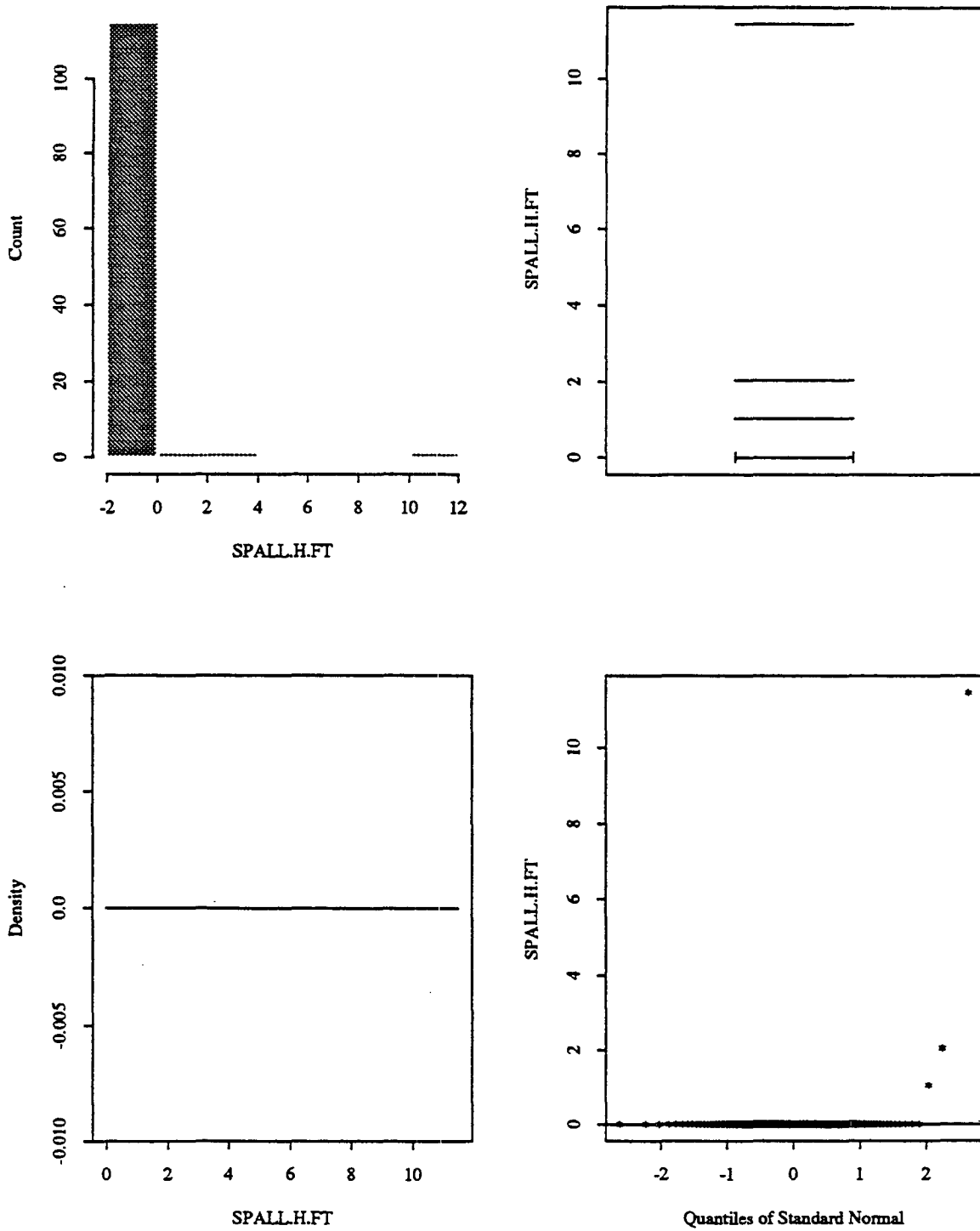


Figure 4.10 Statistical Distribution of High Severity Spalling for GPS-3 Sections, ft

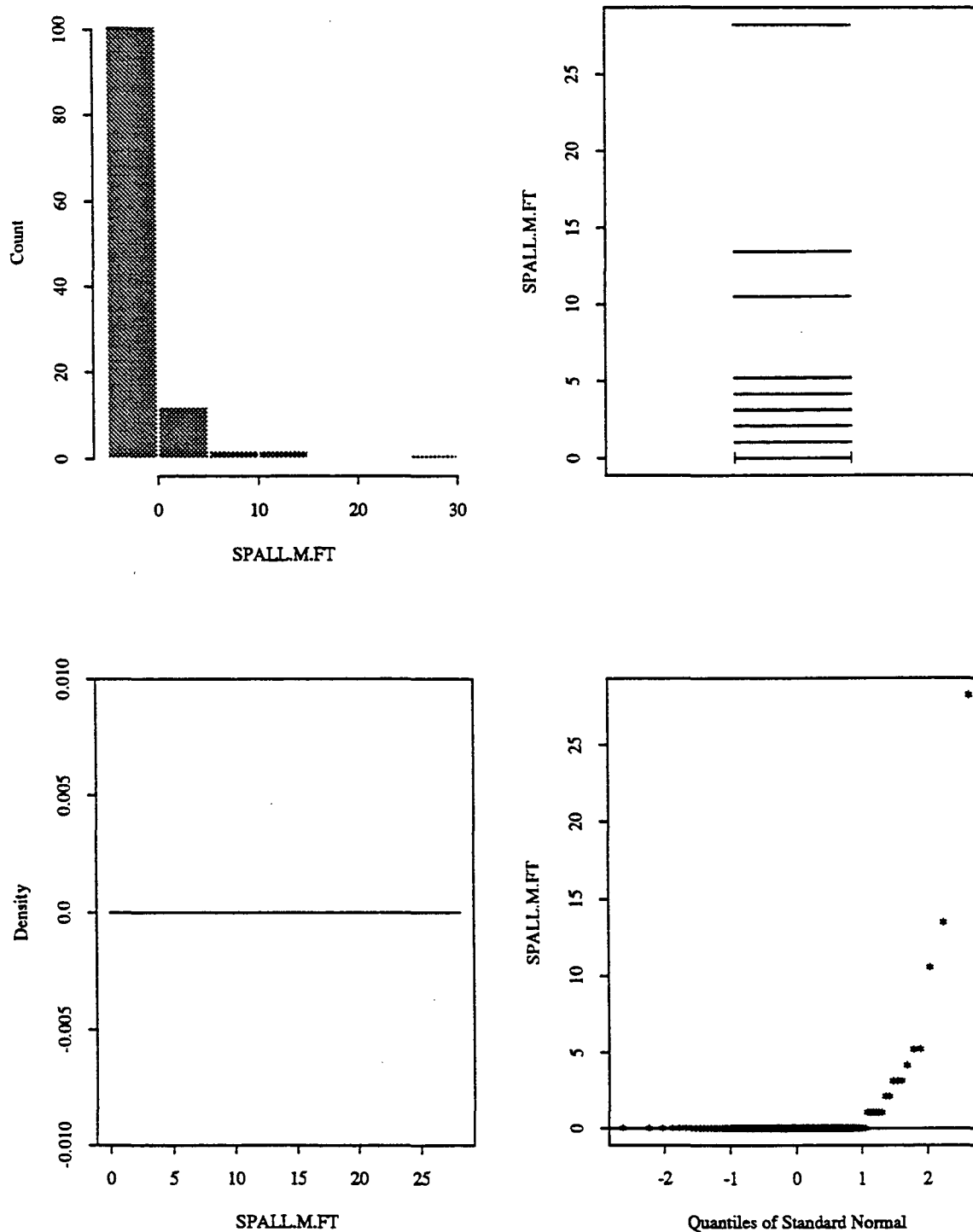


Figure 4.11 Statistical Distribution of Medium Severity Spalling for GPS-3 Sections, ft

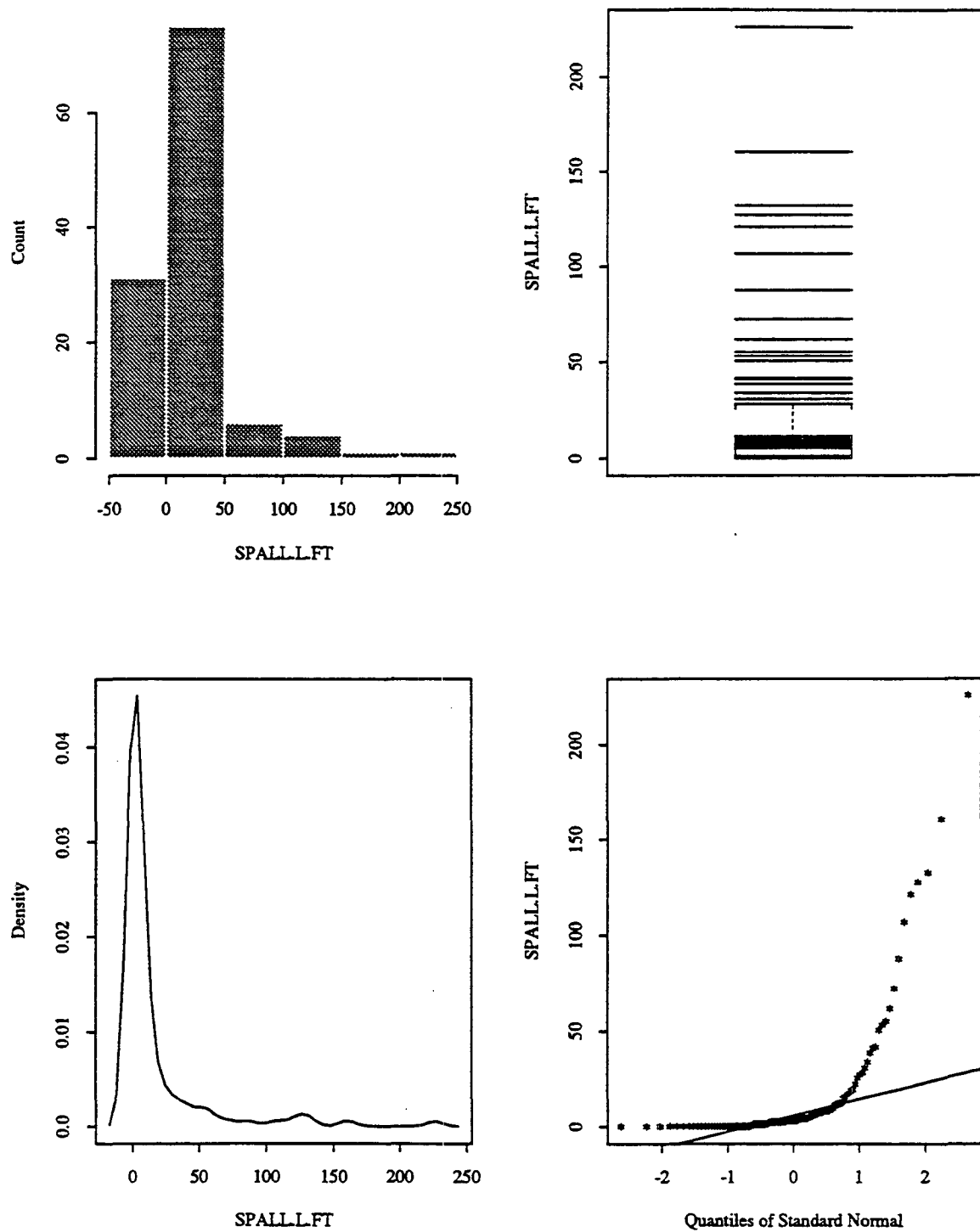


Figure 4.12 Statistical Distribution of Low Severity Spalling for GPS-3 Sections, ft

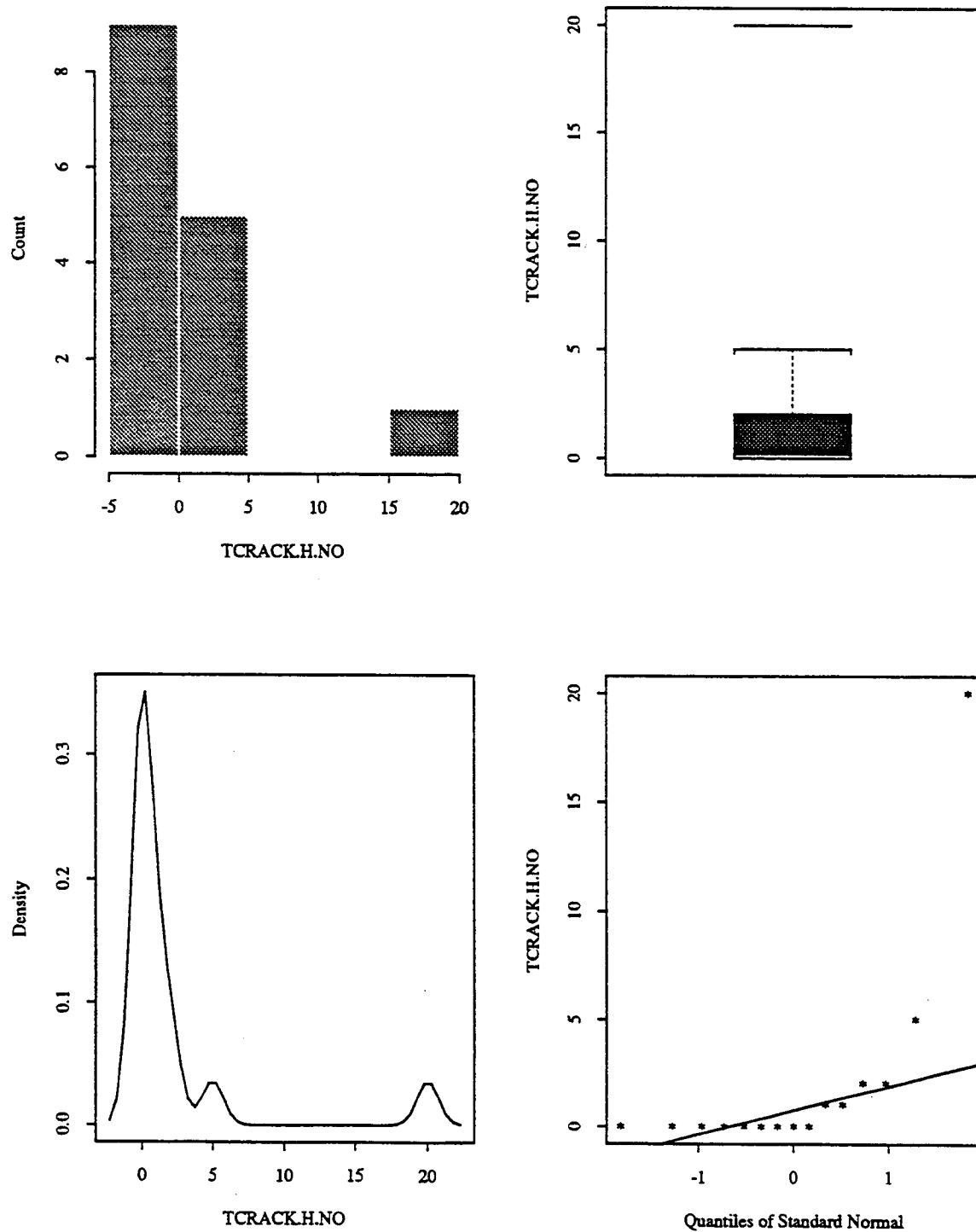


Figure 4.13 Statistical Distribution of High Severity Transverse Cracking for GPS-3 Sections, Number

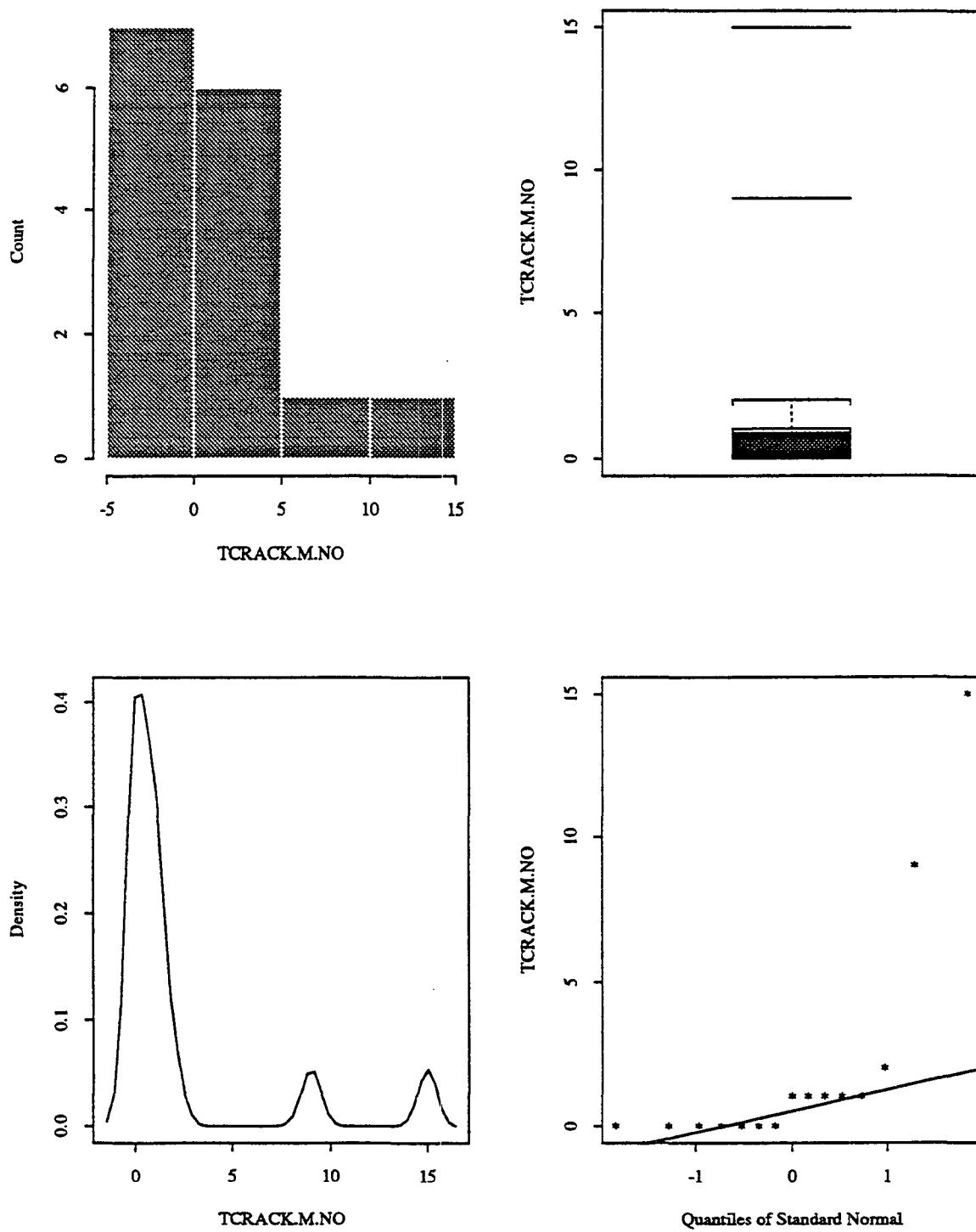


Figure 4.14 Statistical Distribution of Medium Severity Transverse Cracking for GPS-3 Sections, Number

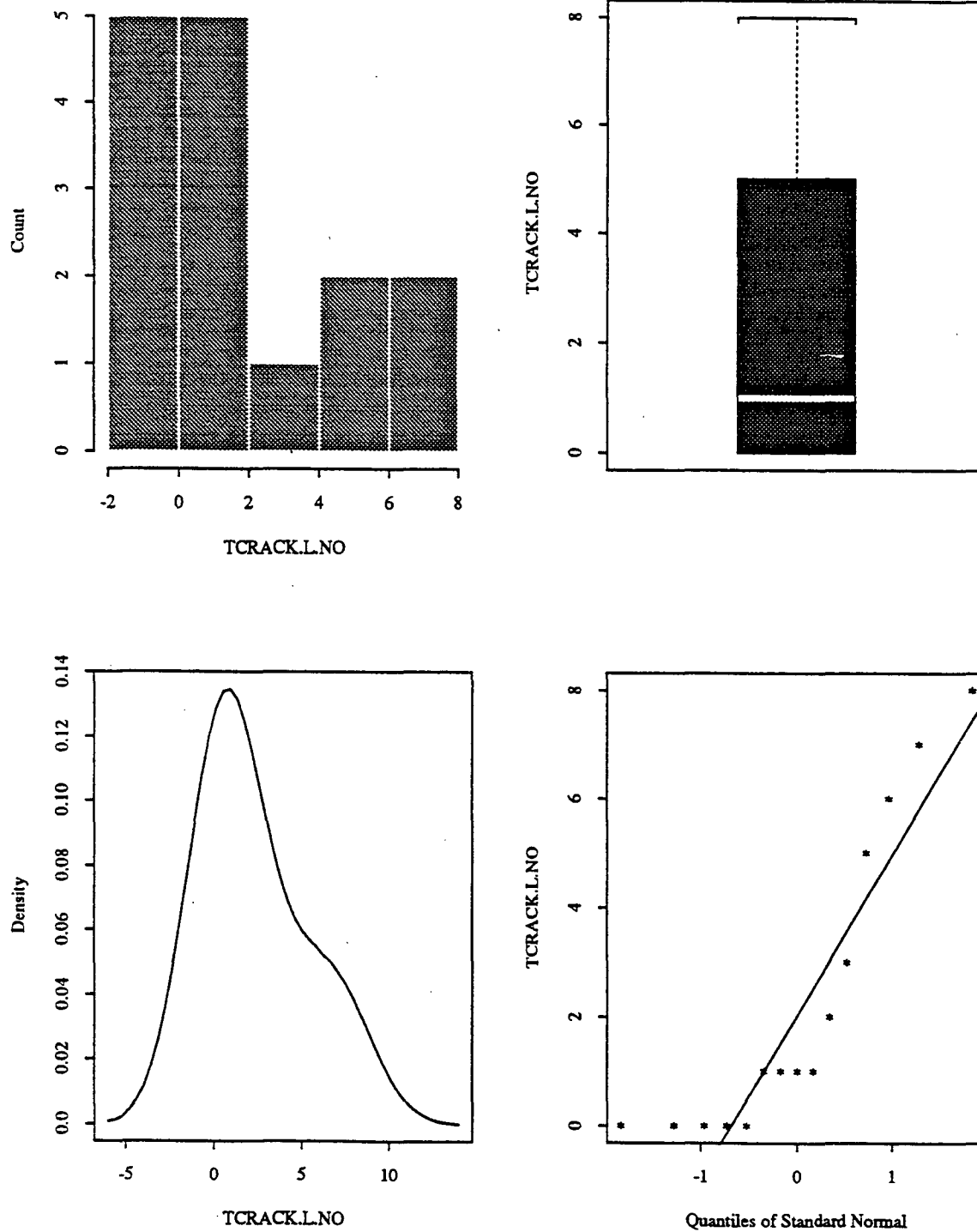


Figure 4.15 Statistical Distribution of Low Severity Transverse Cracking for GPS-3 Sections, Number

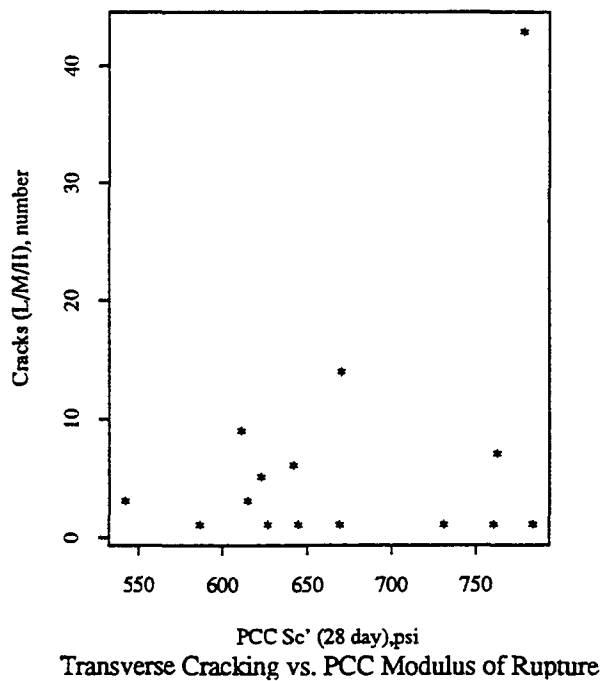
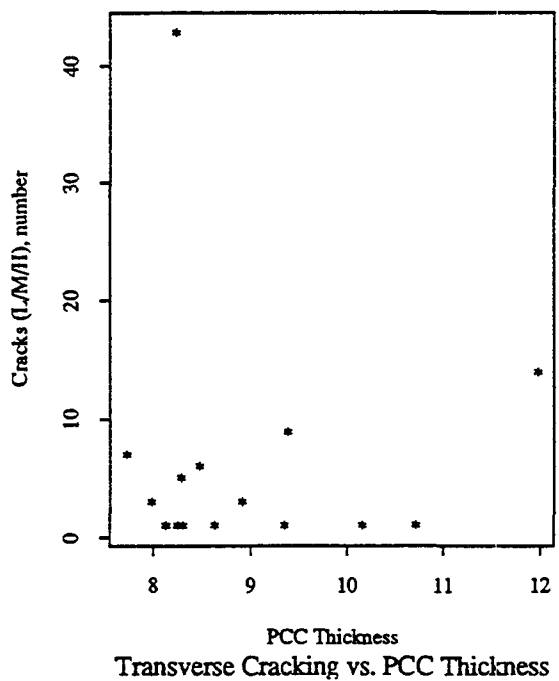
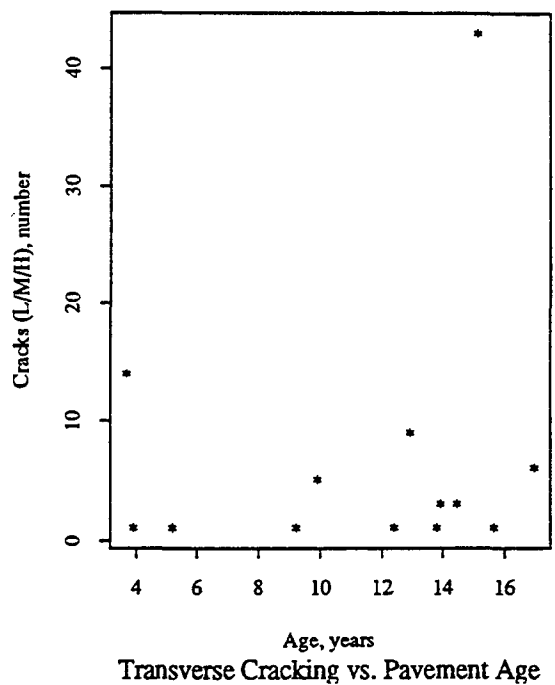
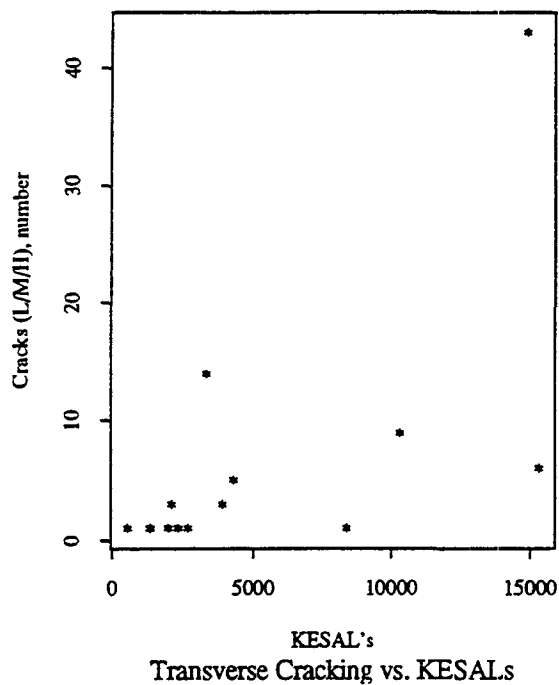


Figure 4.16 Transverse Cracking Scatter Plot for GPS-3 Sections

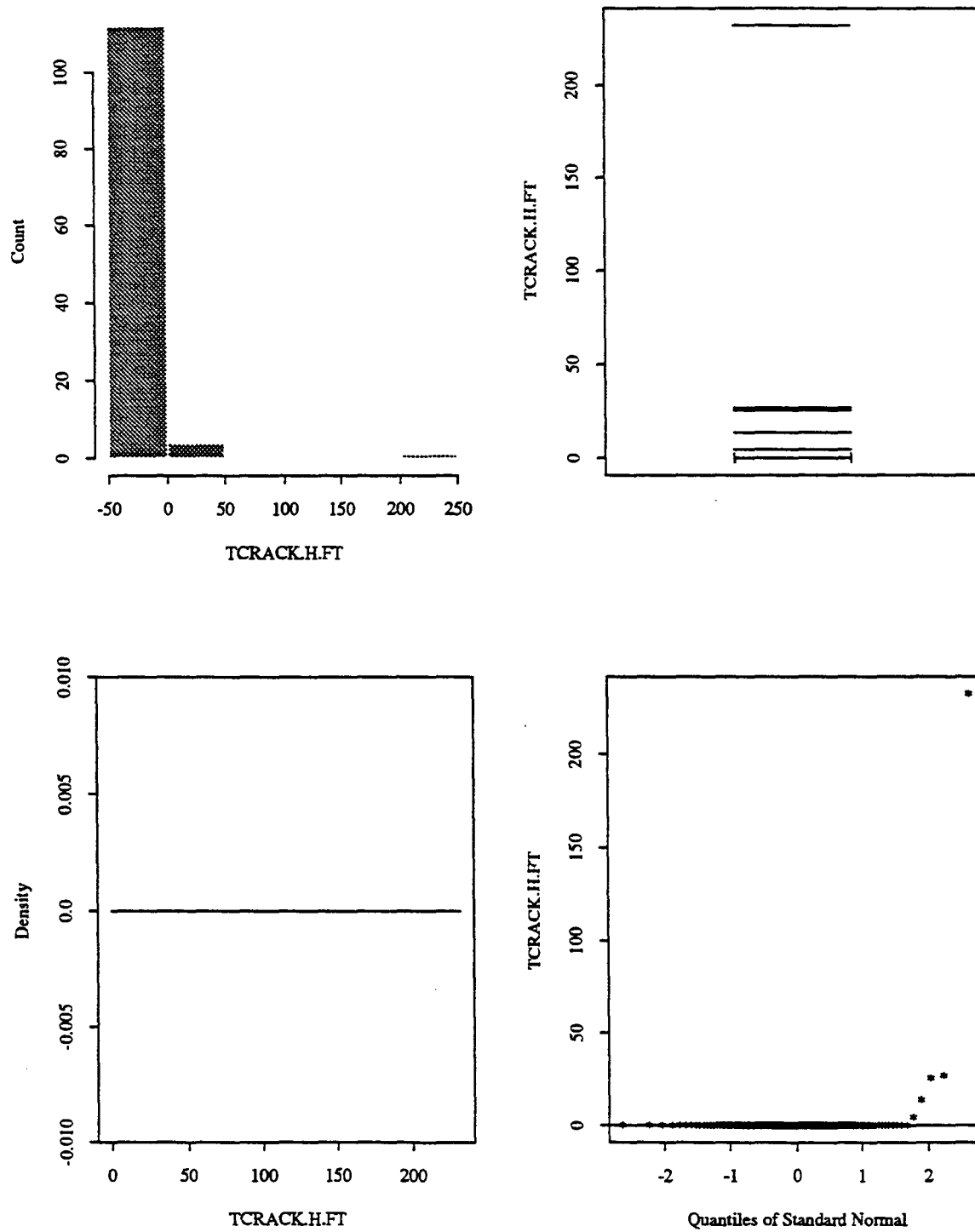


Figure 4.17 Statistical Distribution of High Severity Transverse Cracking for GPS-3 Sections, ft

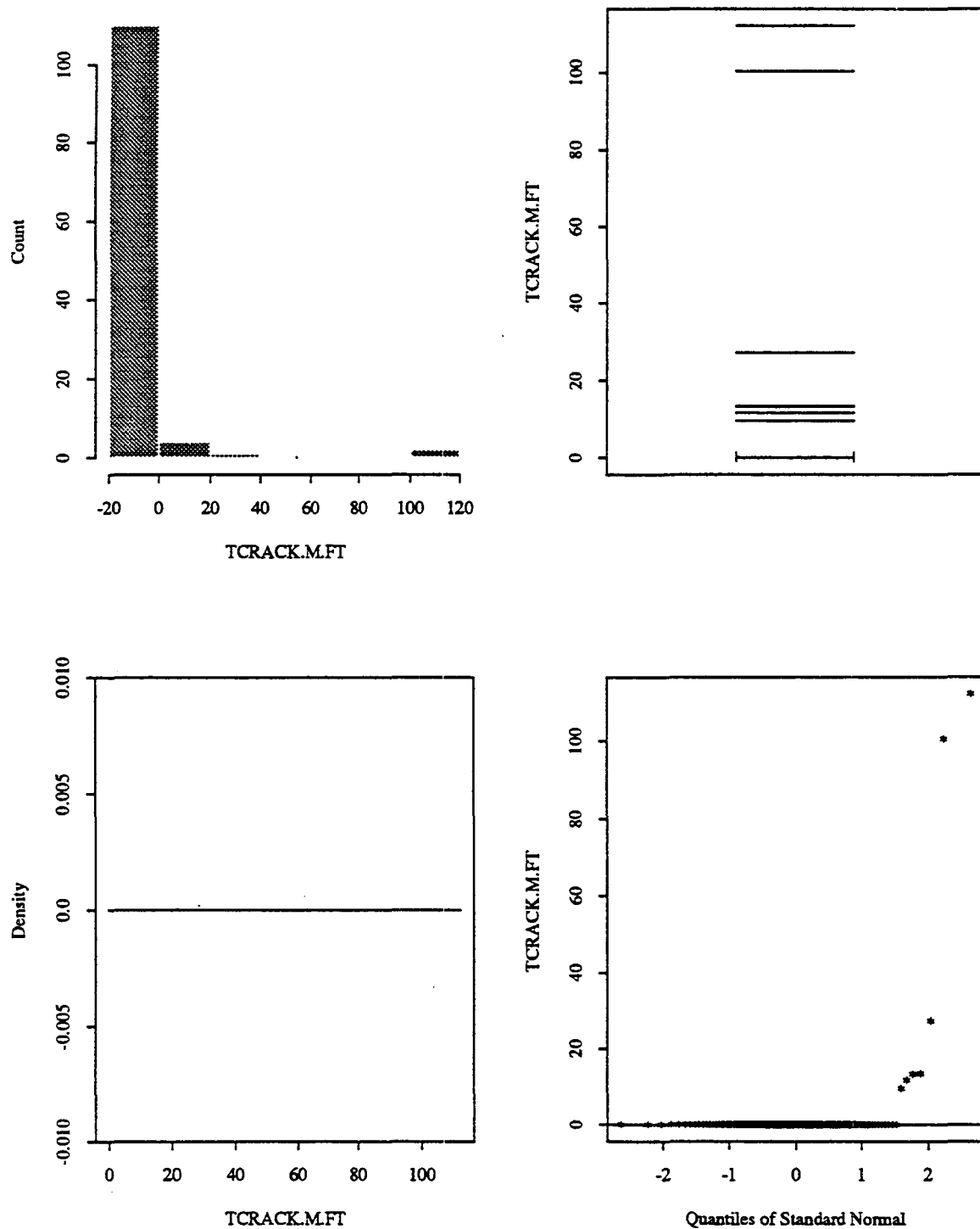


Figure 4.18 Statistical Distribution of Medium Severity Transverse Cracking for GPS-3 Sections, ft

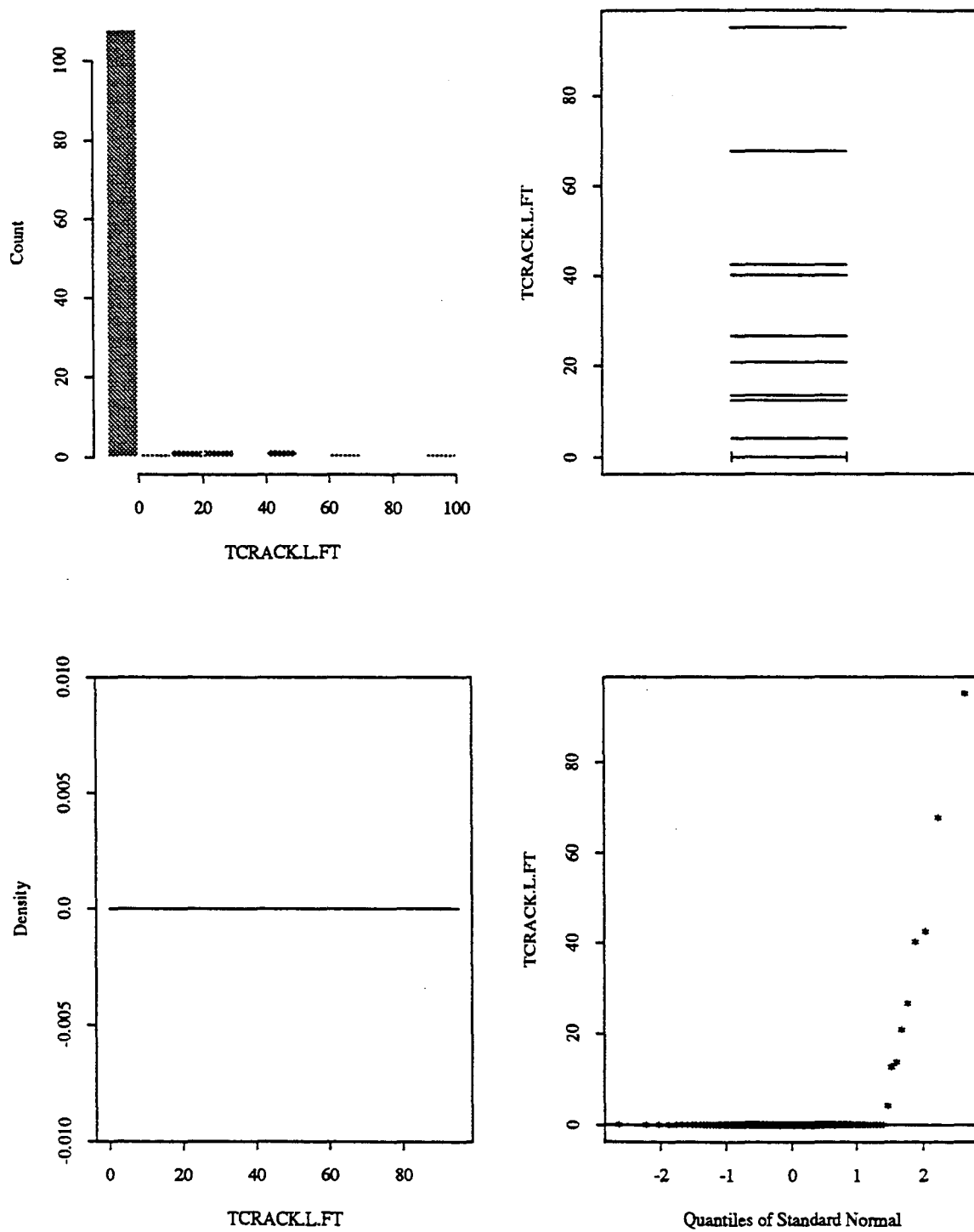


Figure 4.19 Statistical Distribution of Low Severity Transverse Cracking for GPS-3 Sections, ft

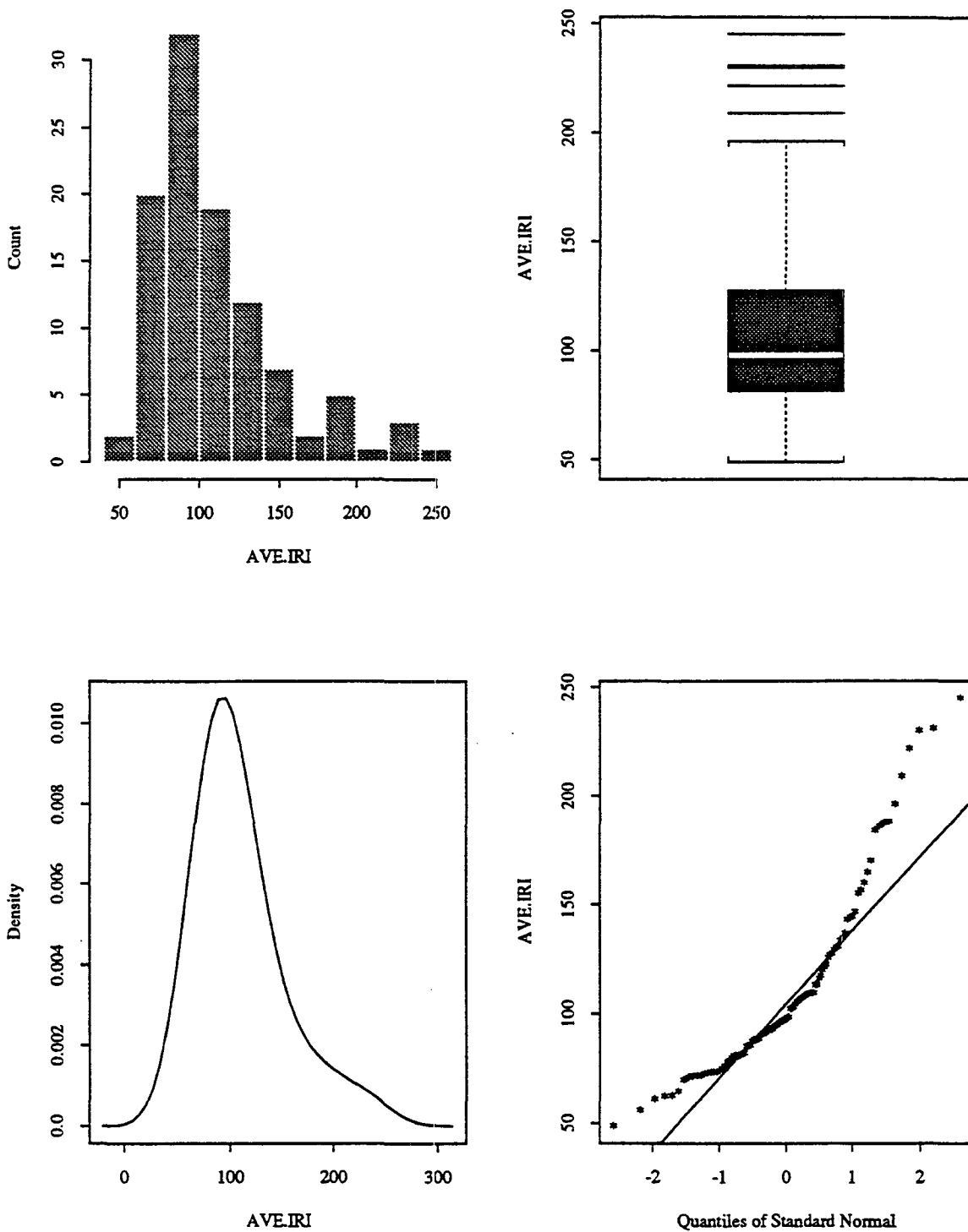


Figure 4.20 Statistical Distribution of Average IRI for GPS-3 Sections, in/mile

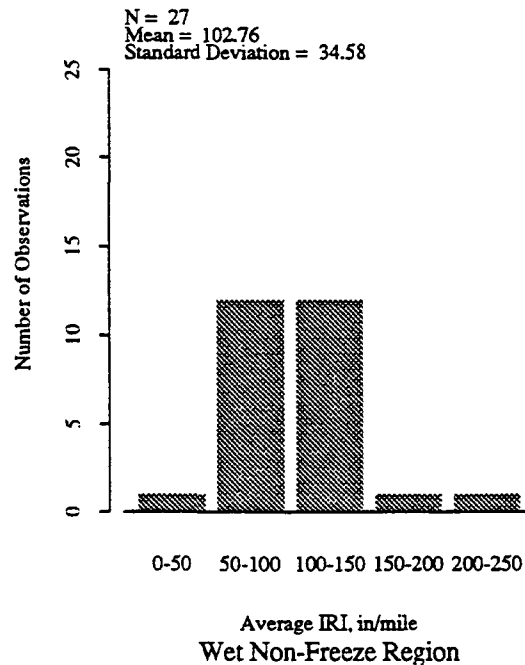
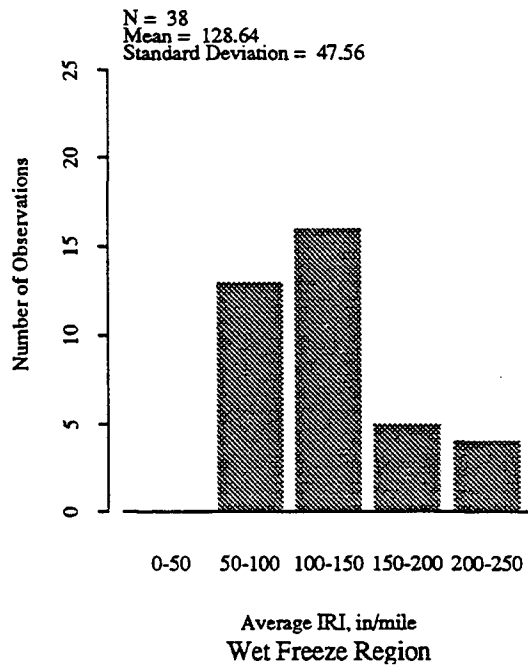
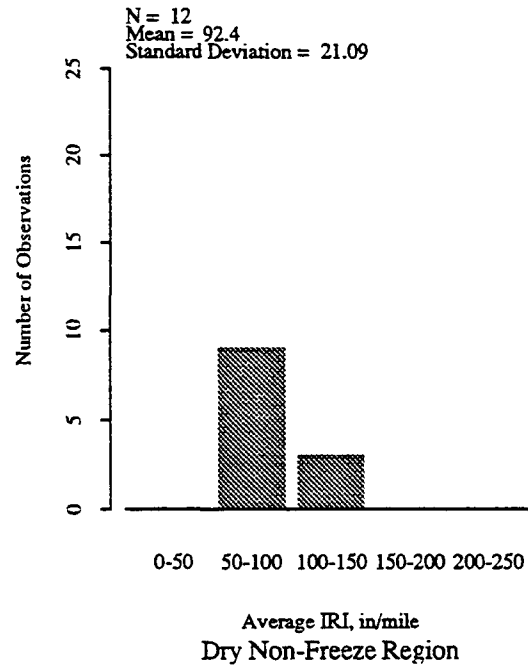
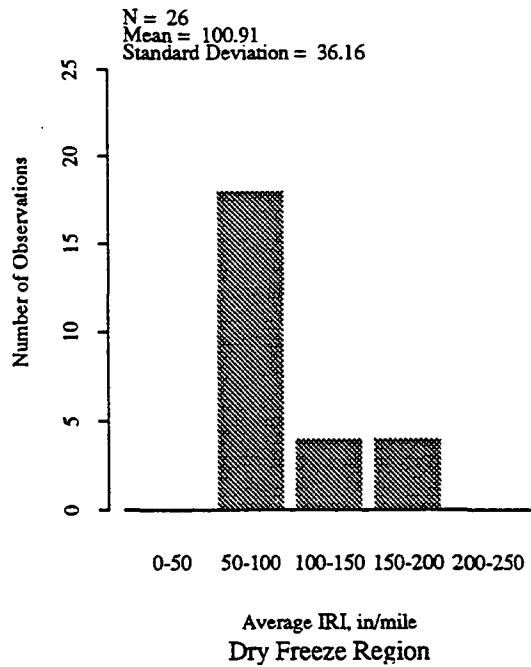


Figure 4.21 Distribution of Average IRI by Environmental Regions for GPS-3 Sections

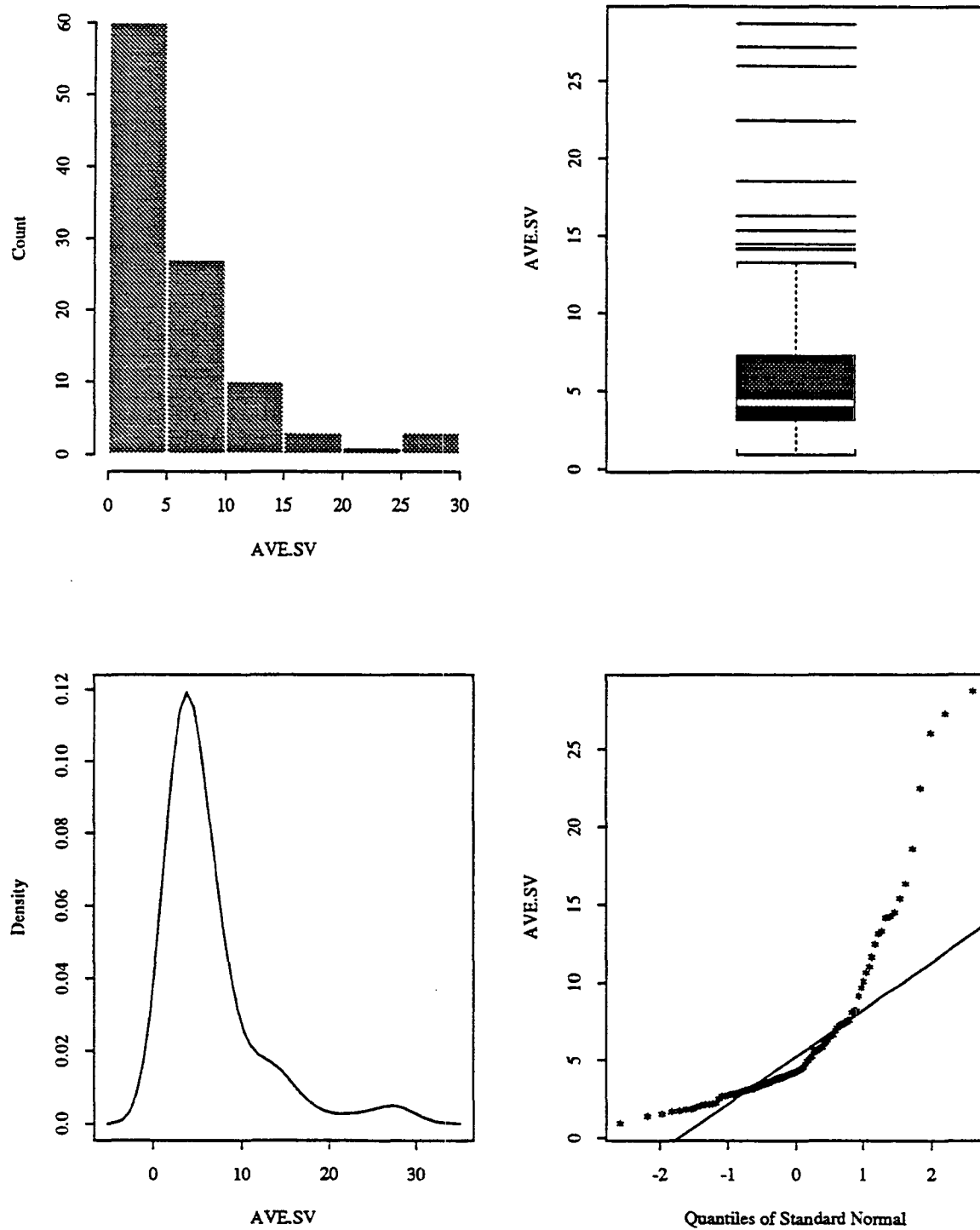


Figure 4.22 Statistical Distribution of Average Slope Variance in GPS-3 Sections

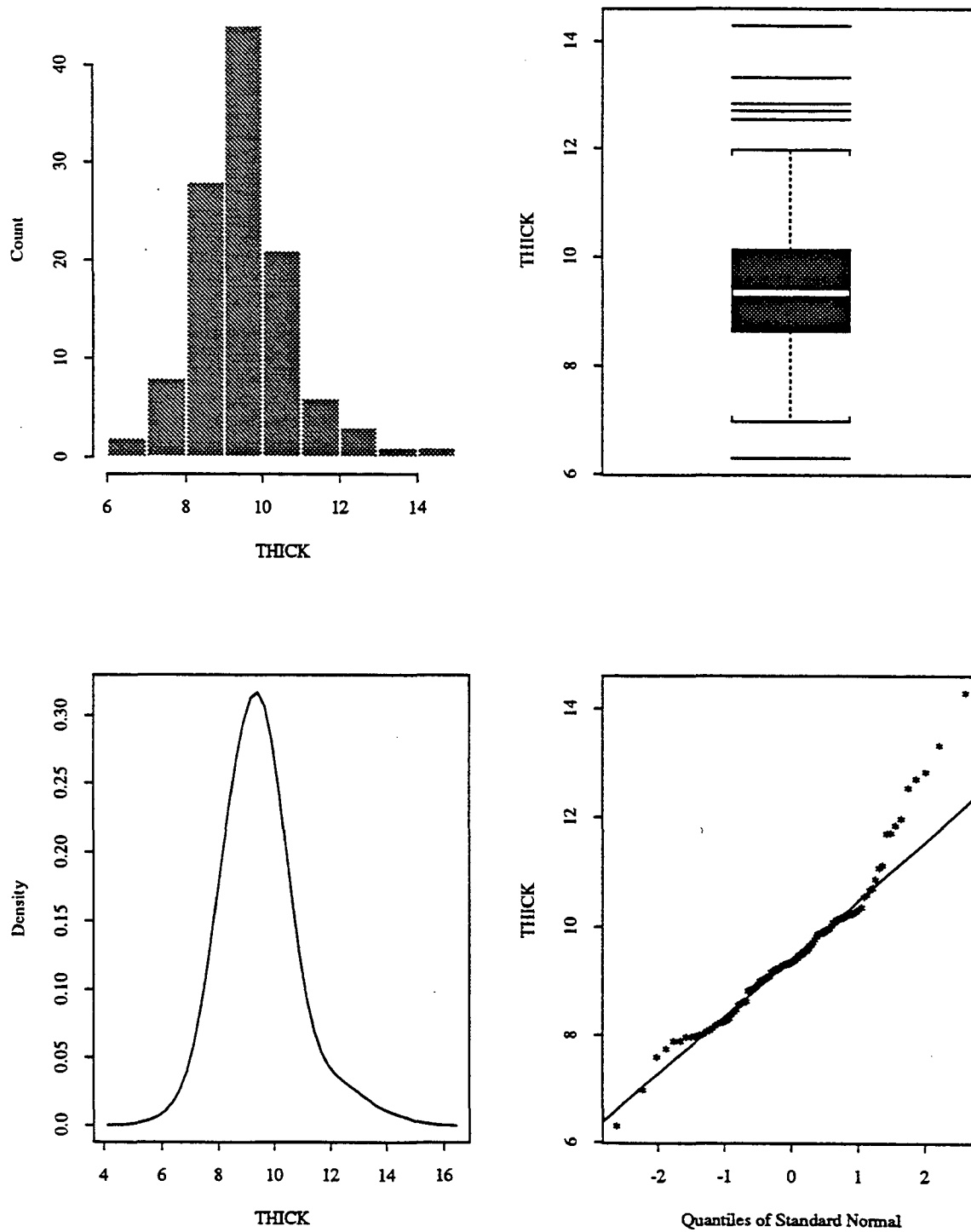


Figure 4.23 Statistical Distribution of PCC Thickness for GPS-3 Sections

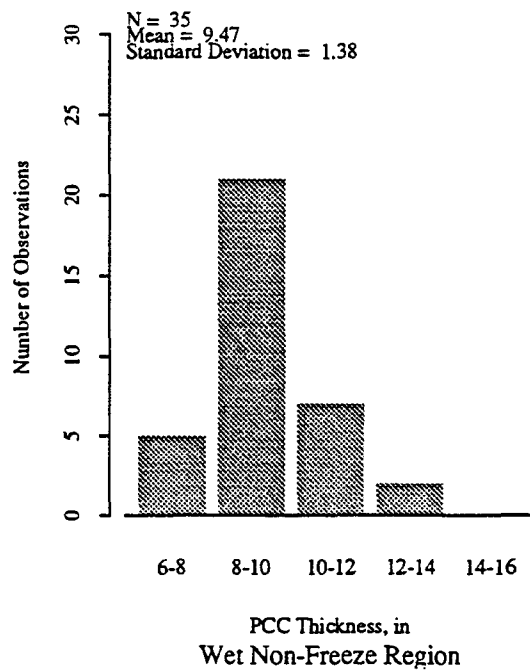
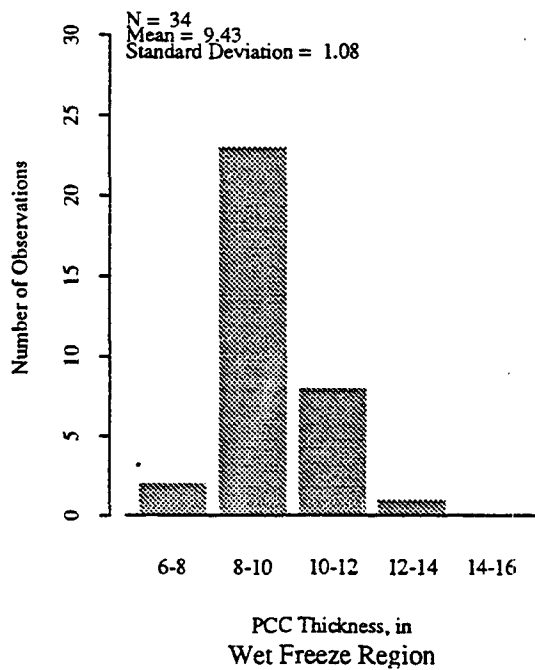
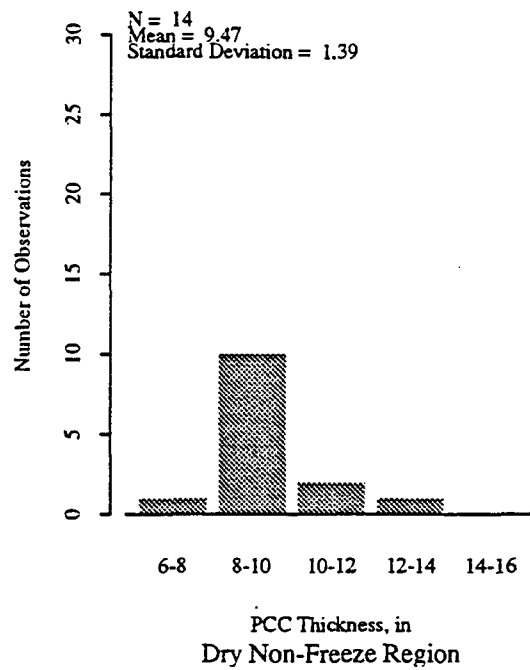
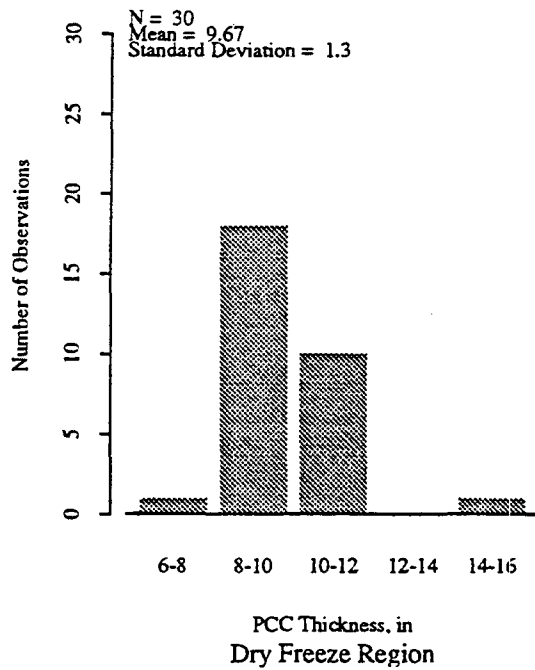


Figure 4.24 Distribution of PCC Thickness by Environmental Regions for GPS-3 Sections

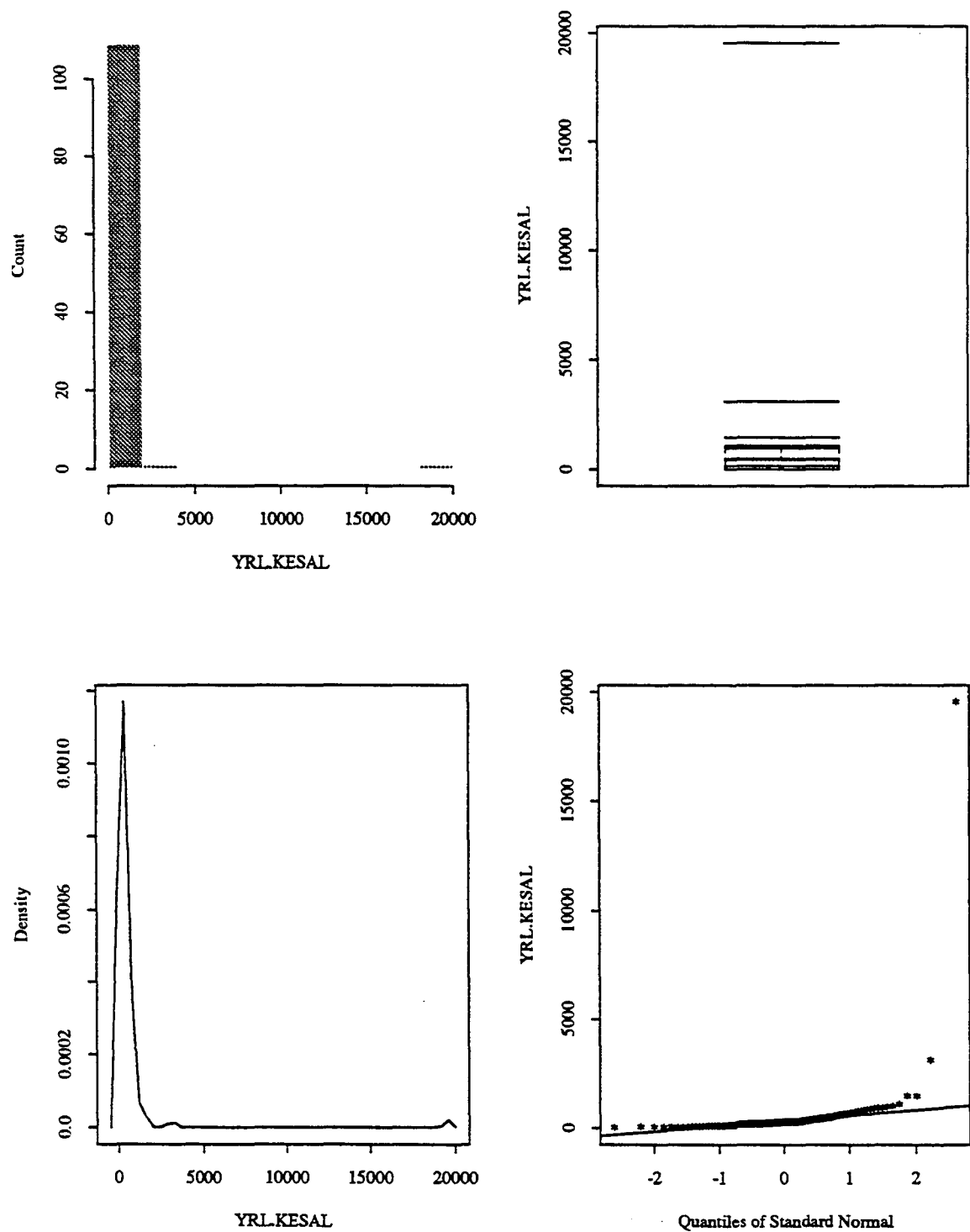


Figure 4.25 Statistical Distribution of KESALs/Year for GPS-3 Sections

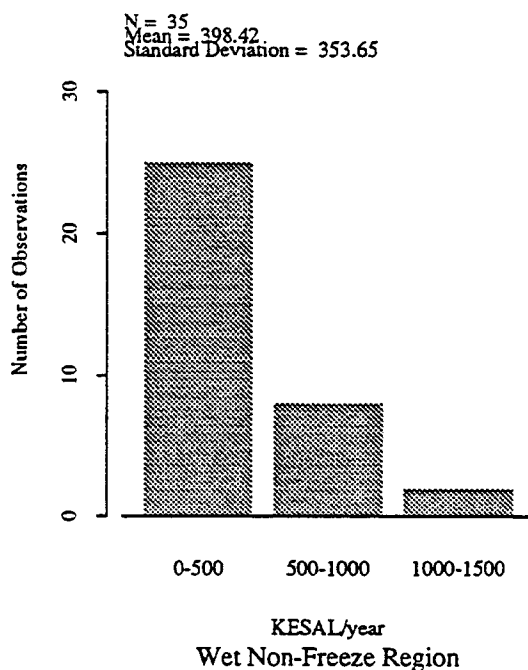
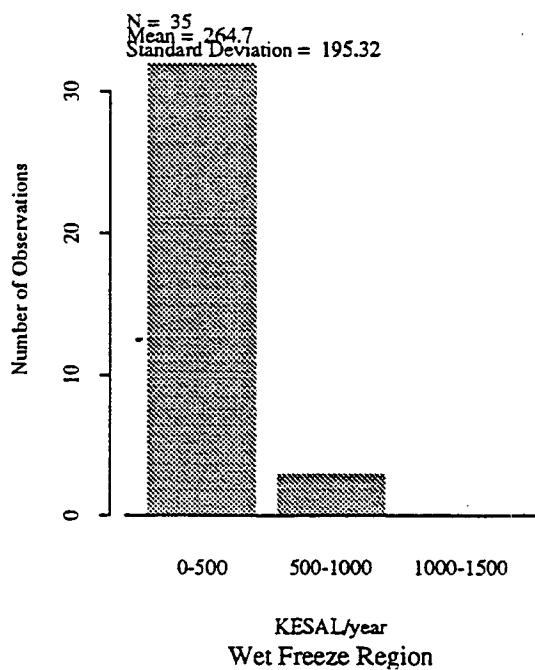
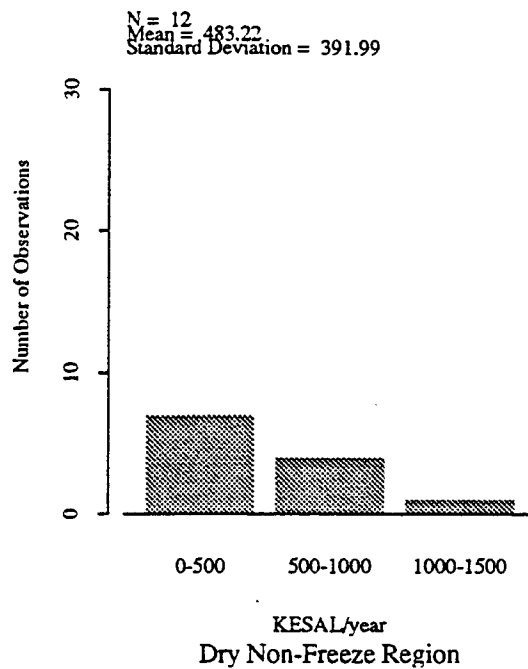
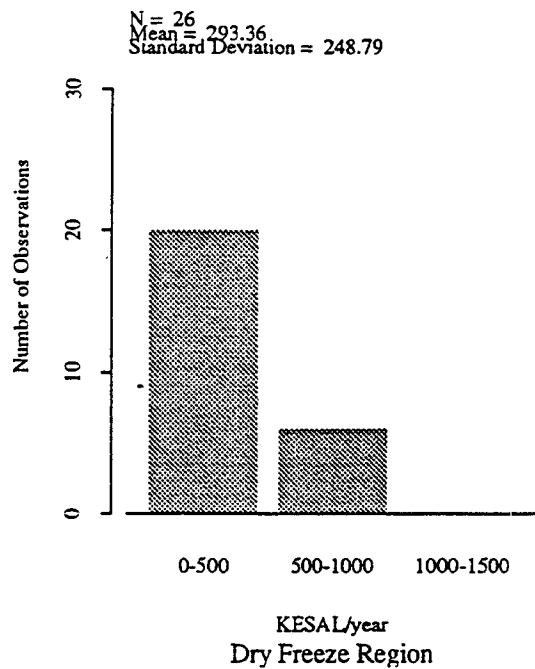


Figure 4.26 Distribution of KESALs/Year by Environmental Regions for GPS-3 Sections

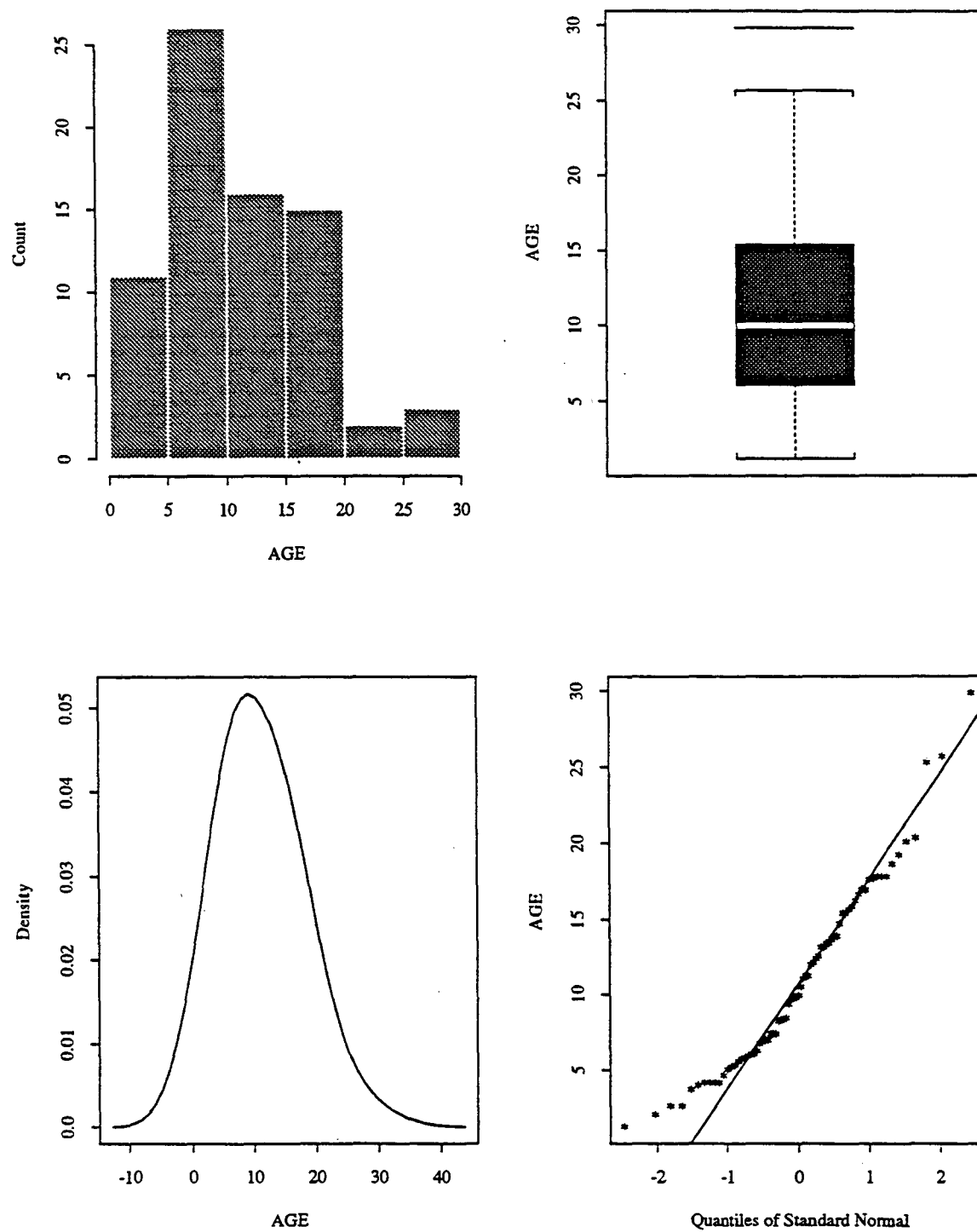


Figure 4.27 Statistical Distribution of Pavement Age for GPS-3 Sections, Years

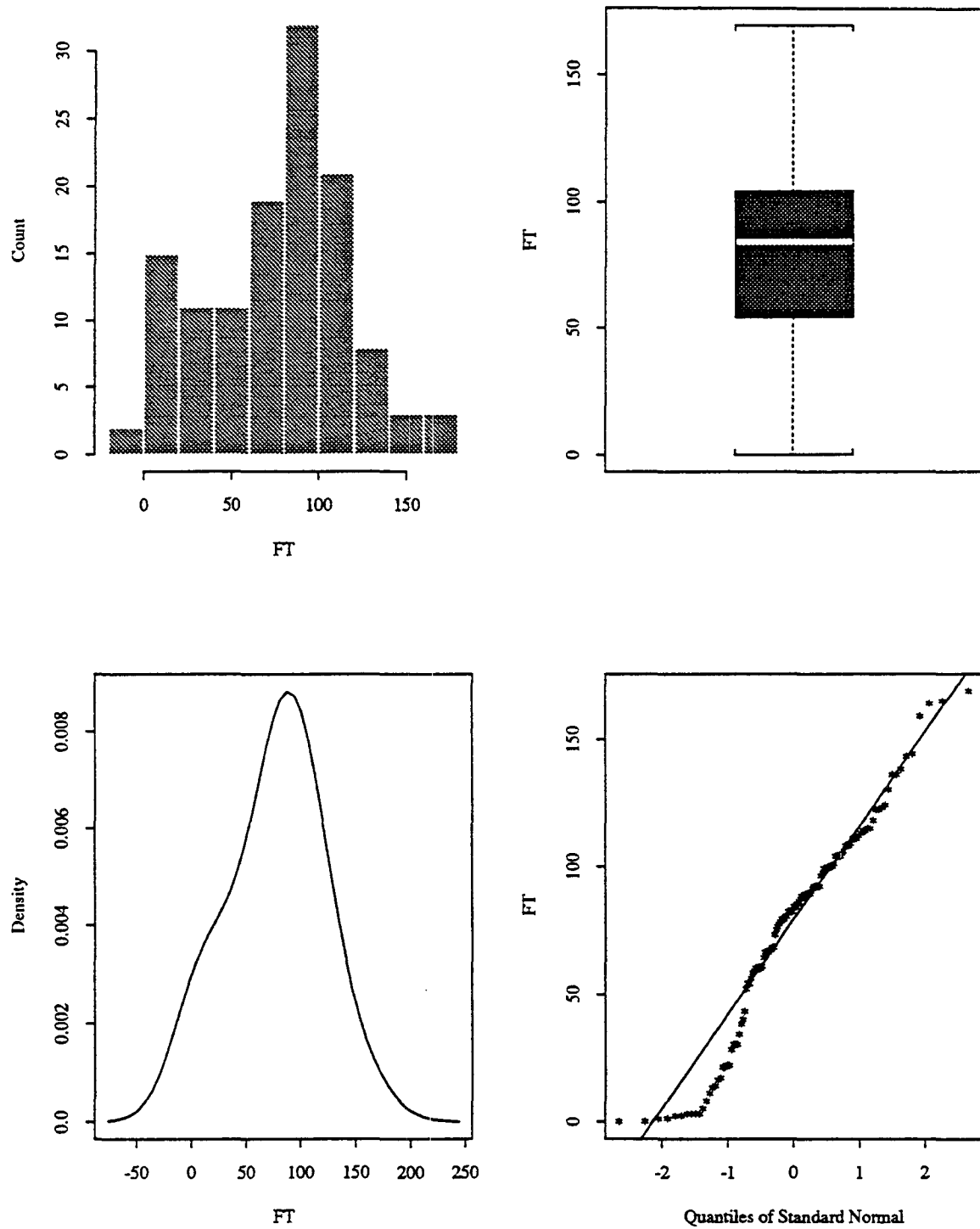


Figure 4.28 Statistical Distribution of Freeze-Thaw Cycle for GPS-3 Sections, Number

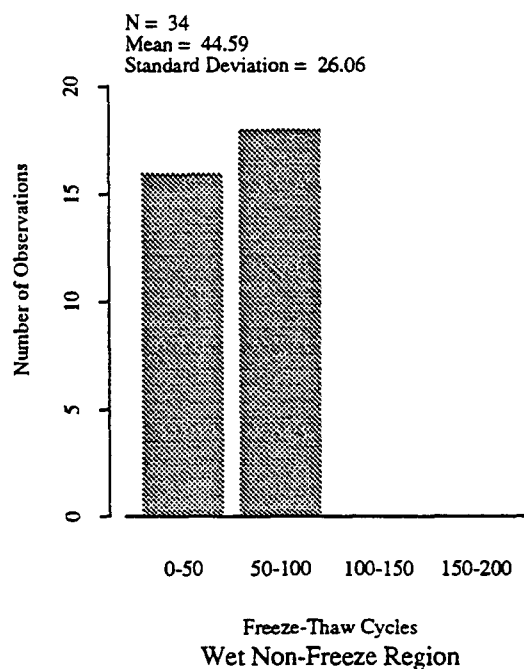
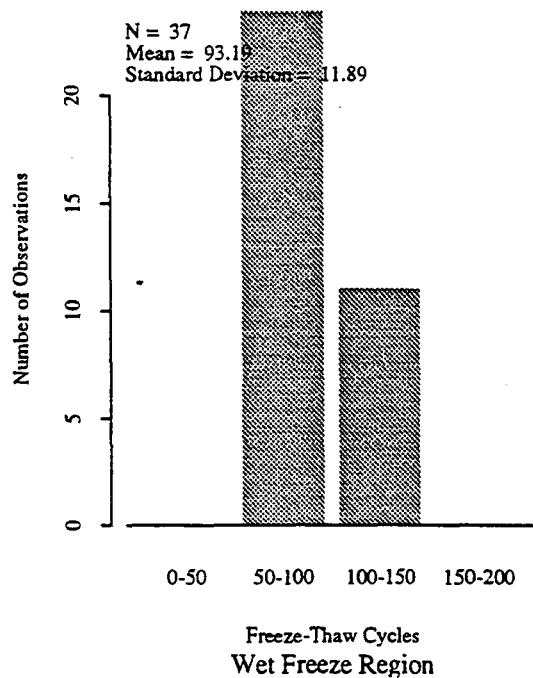
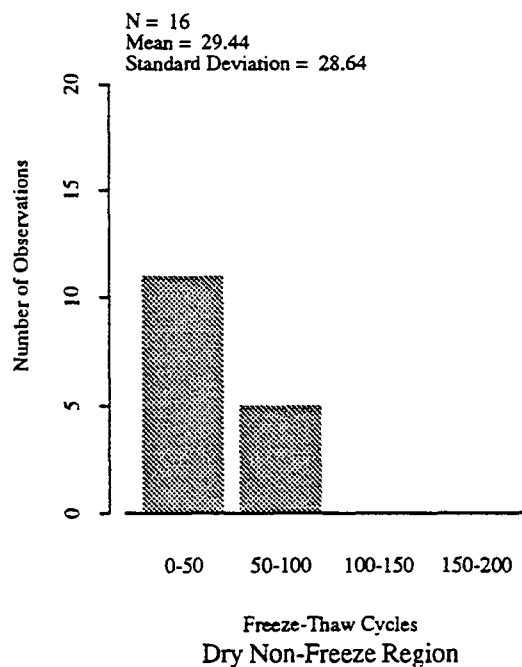
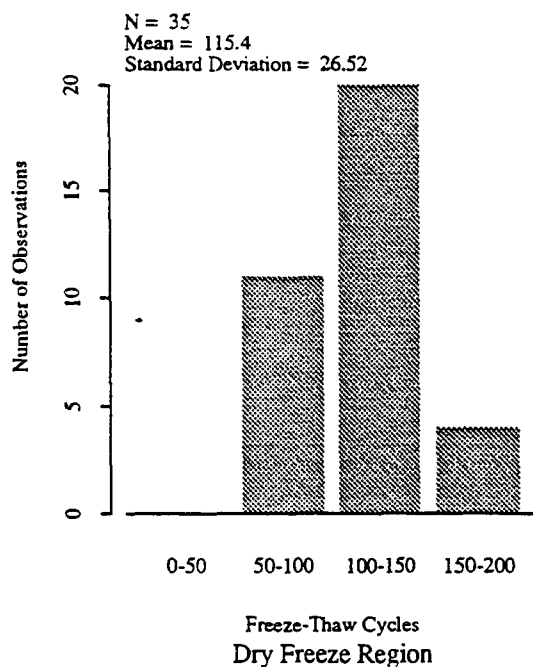


Figure 4.29 Distribution of Freeze-Thaw Cycles by Environmental Regions for GPS-3 Sections, Number

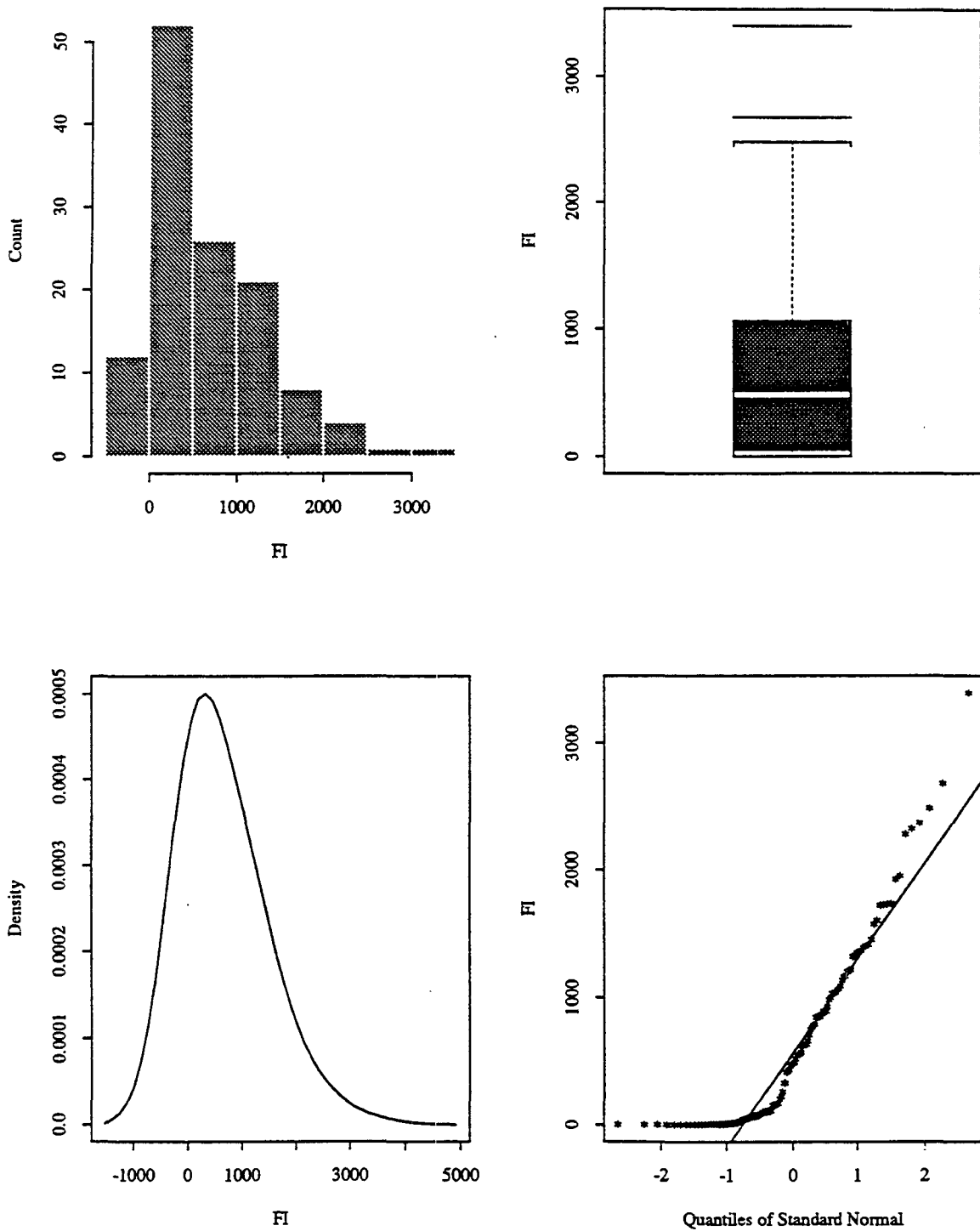


Figure 4.30 Statistical Distribution of Freezing Index for GPS-3 Sections

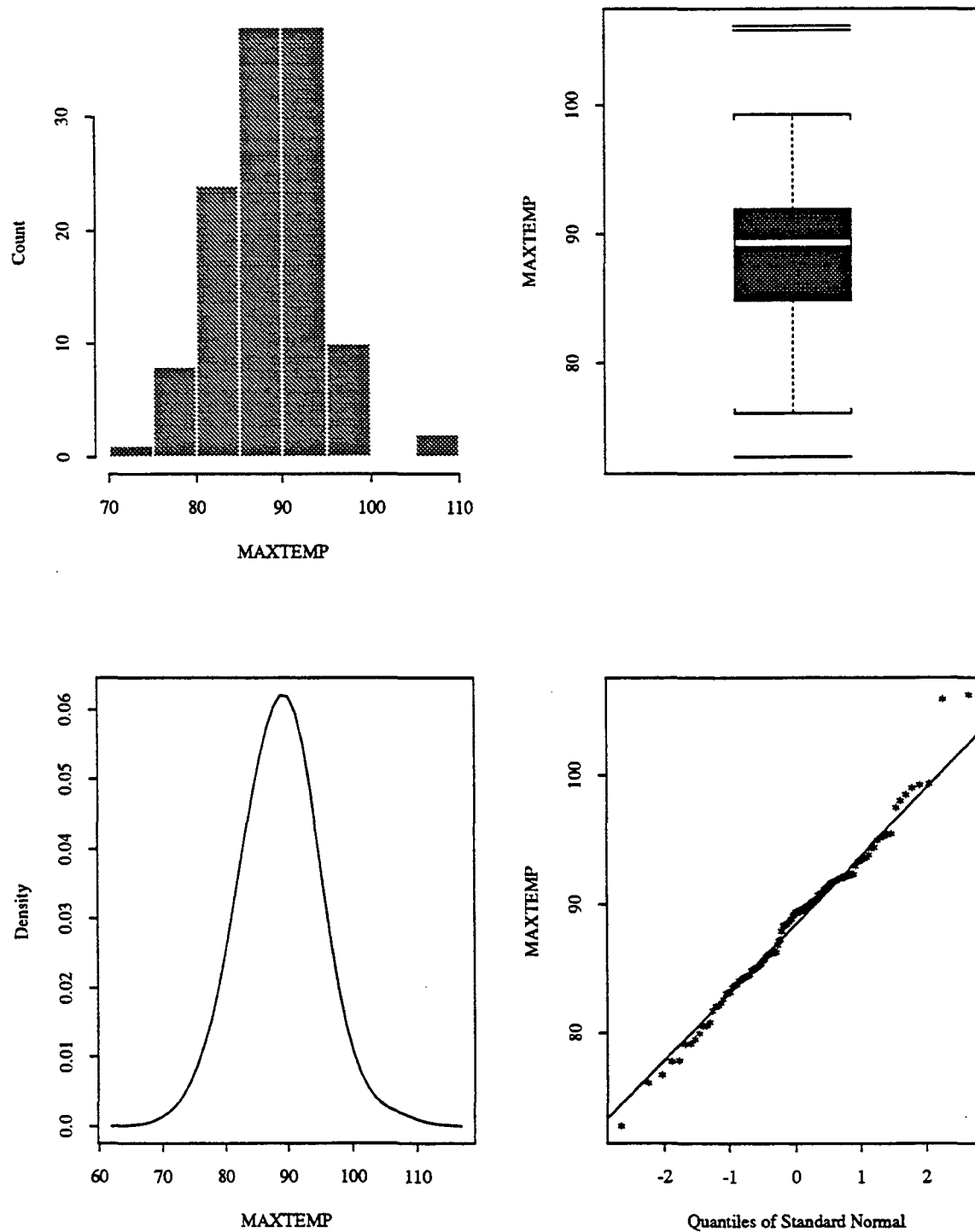


Figure 4.31 Statistical Distribution of Average Monthly Maximum Temperature for GPS-3 Sections, °F

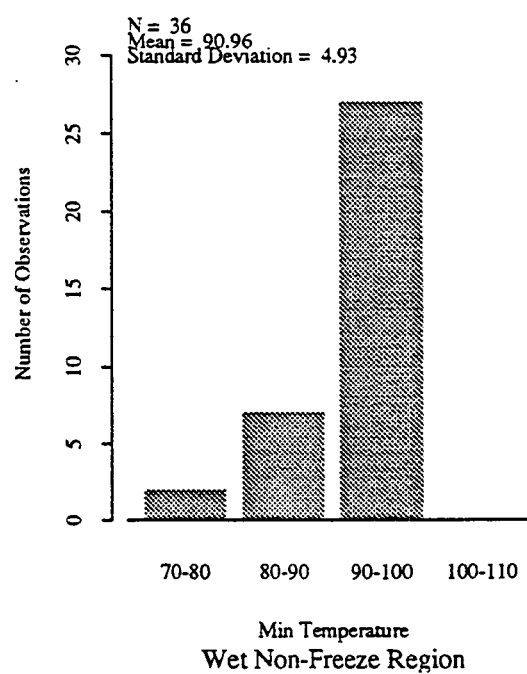
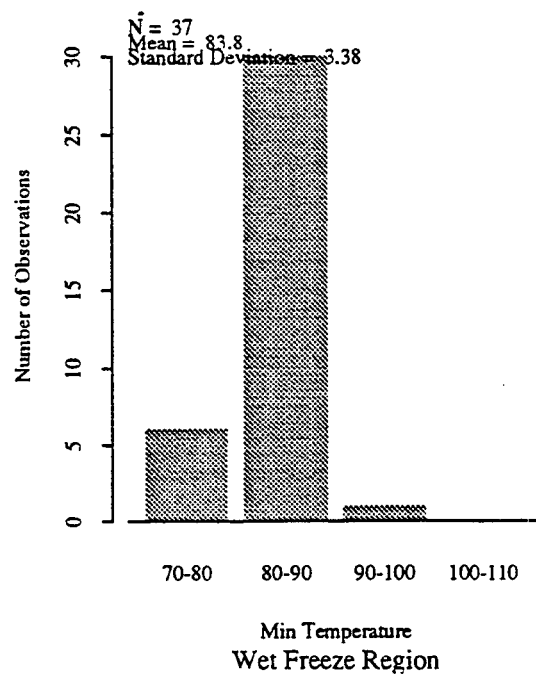
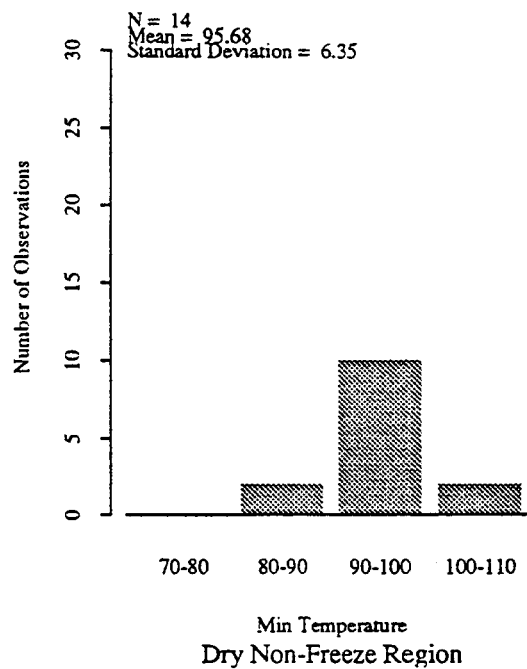
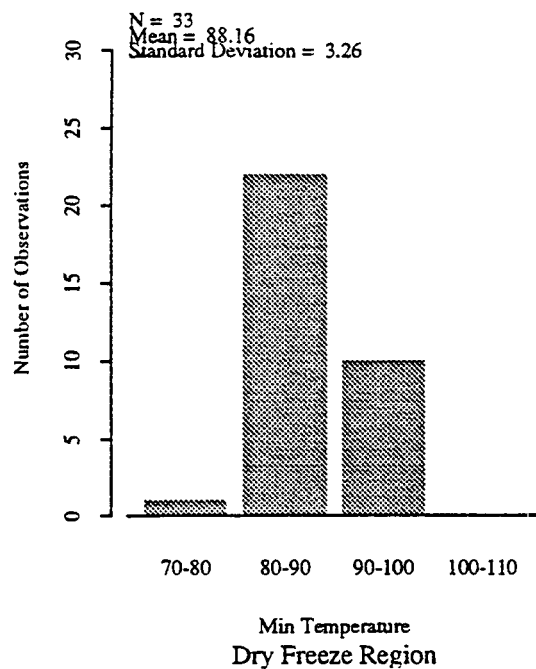


Figure 4.32 Distribution of Max. Temperature by Environmental Regions for GPS-3 Sections, °F

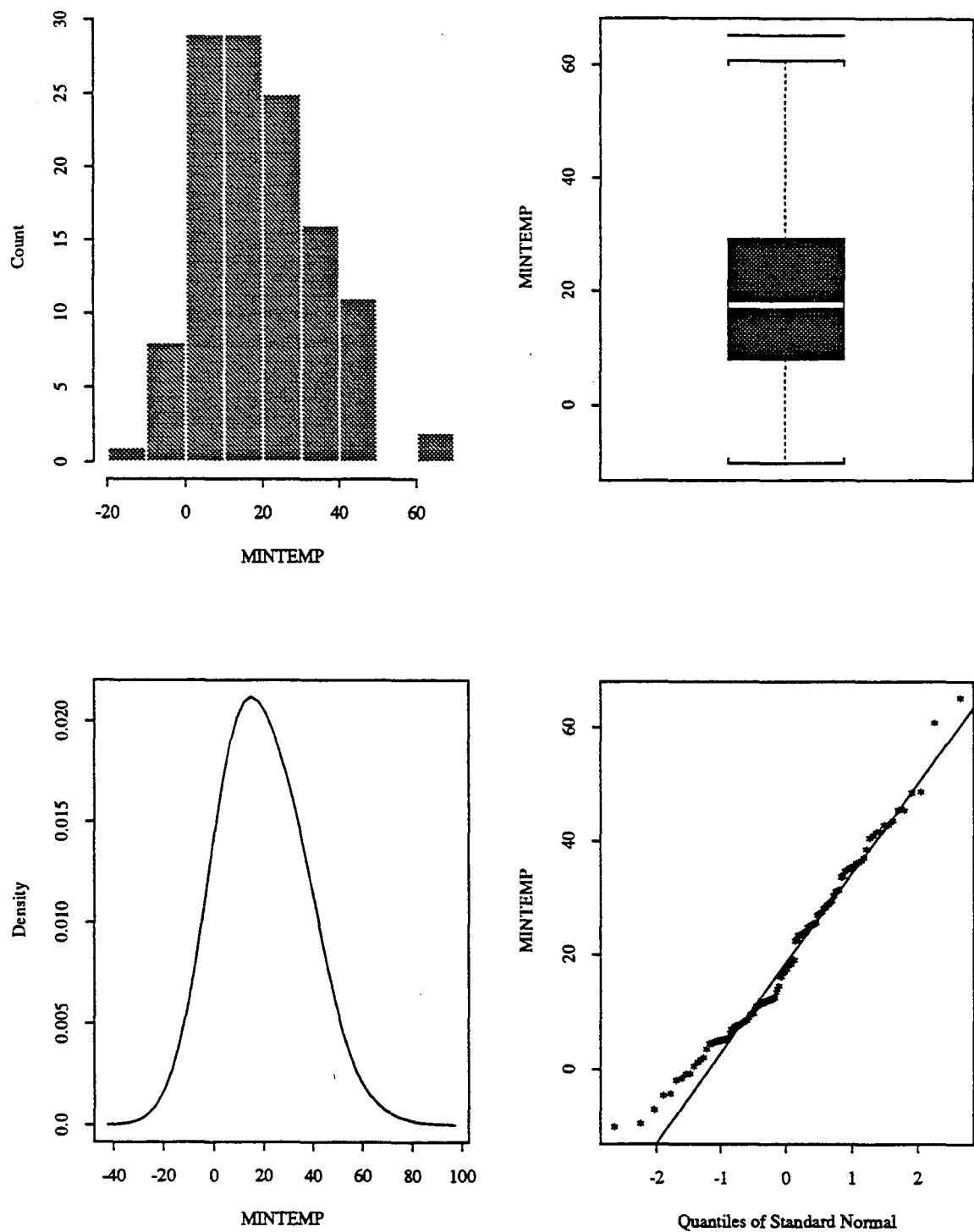


Figure 4.33 Statistical Distribution of Average Monthly Minimum Temperature for GPS-3, Sections, °F

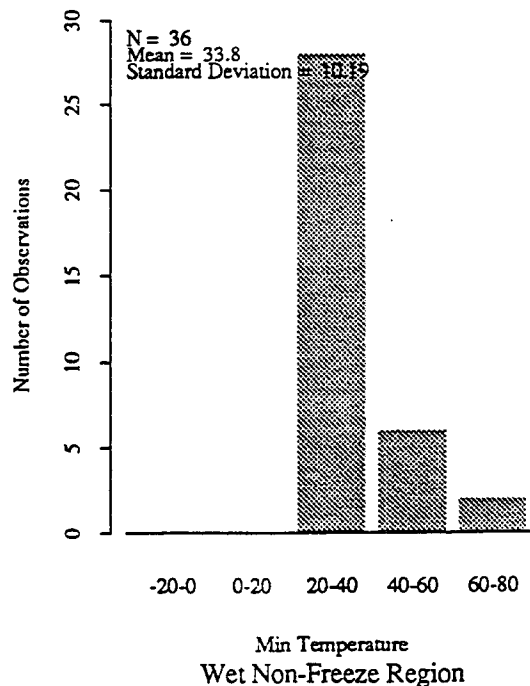
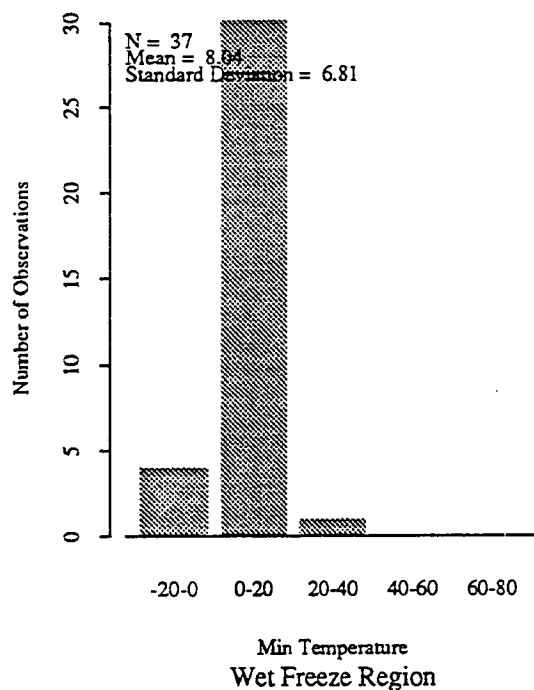
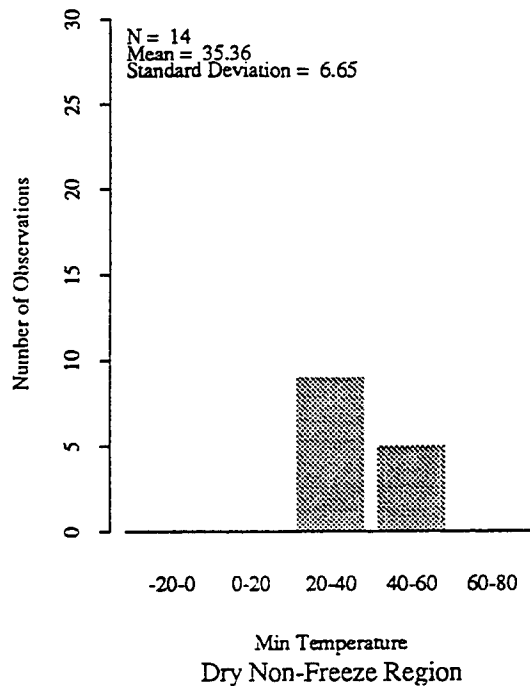
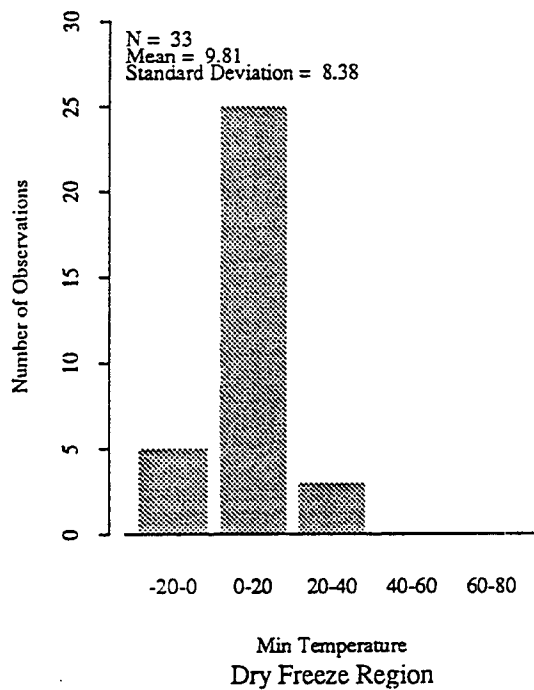


Figure 4.34 Distribution of Min. Temperature by Environmental Regions for GPS-3 Sections, °F

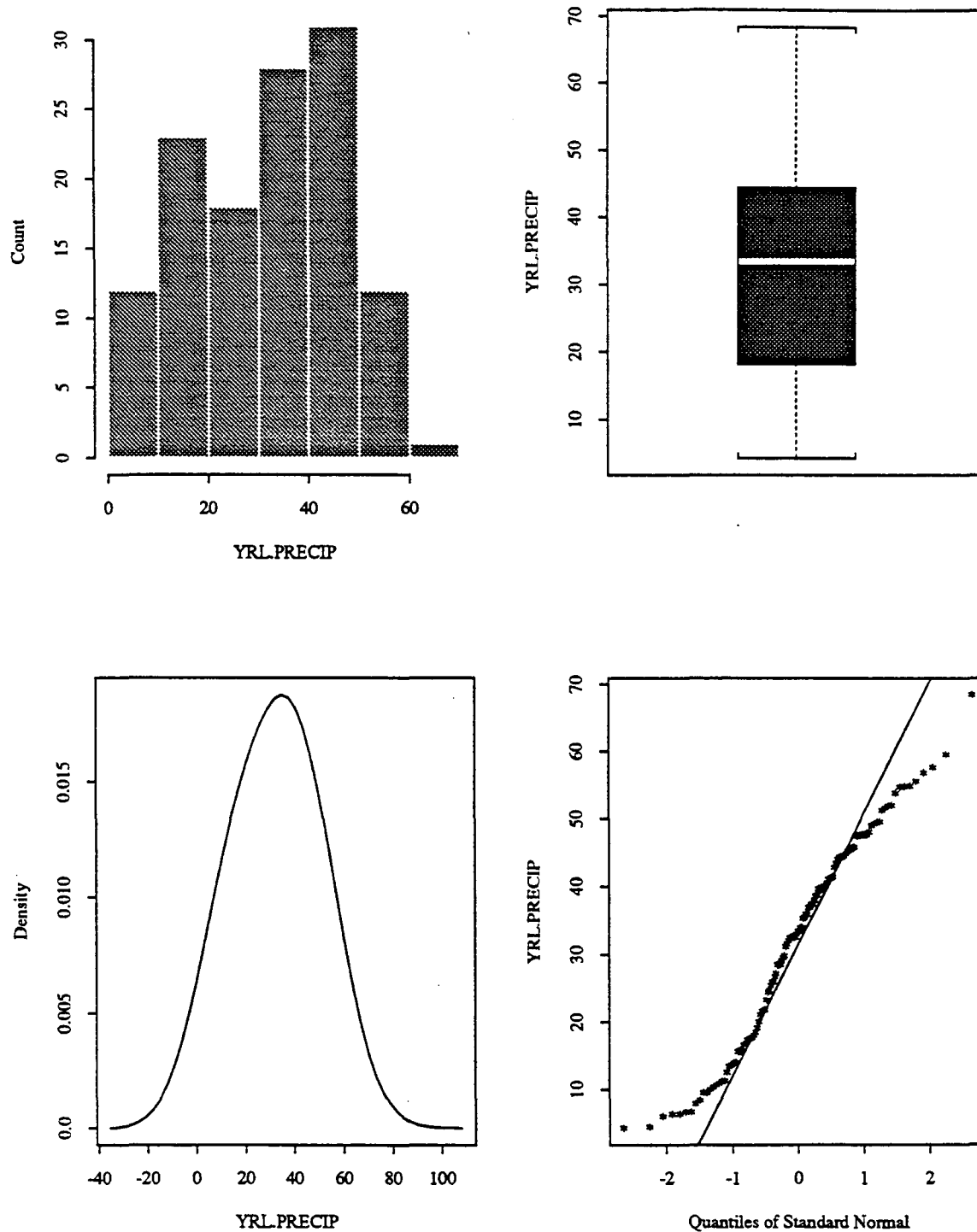


Figure 4.35 Statistical Distribution of Average Yearly Precipitation for GPS-3 Sections, In.

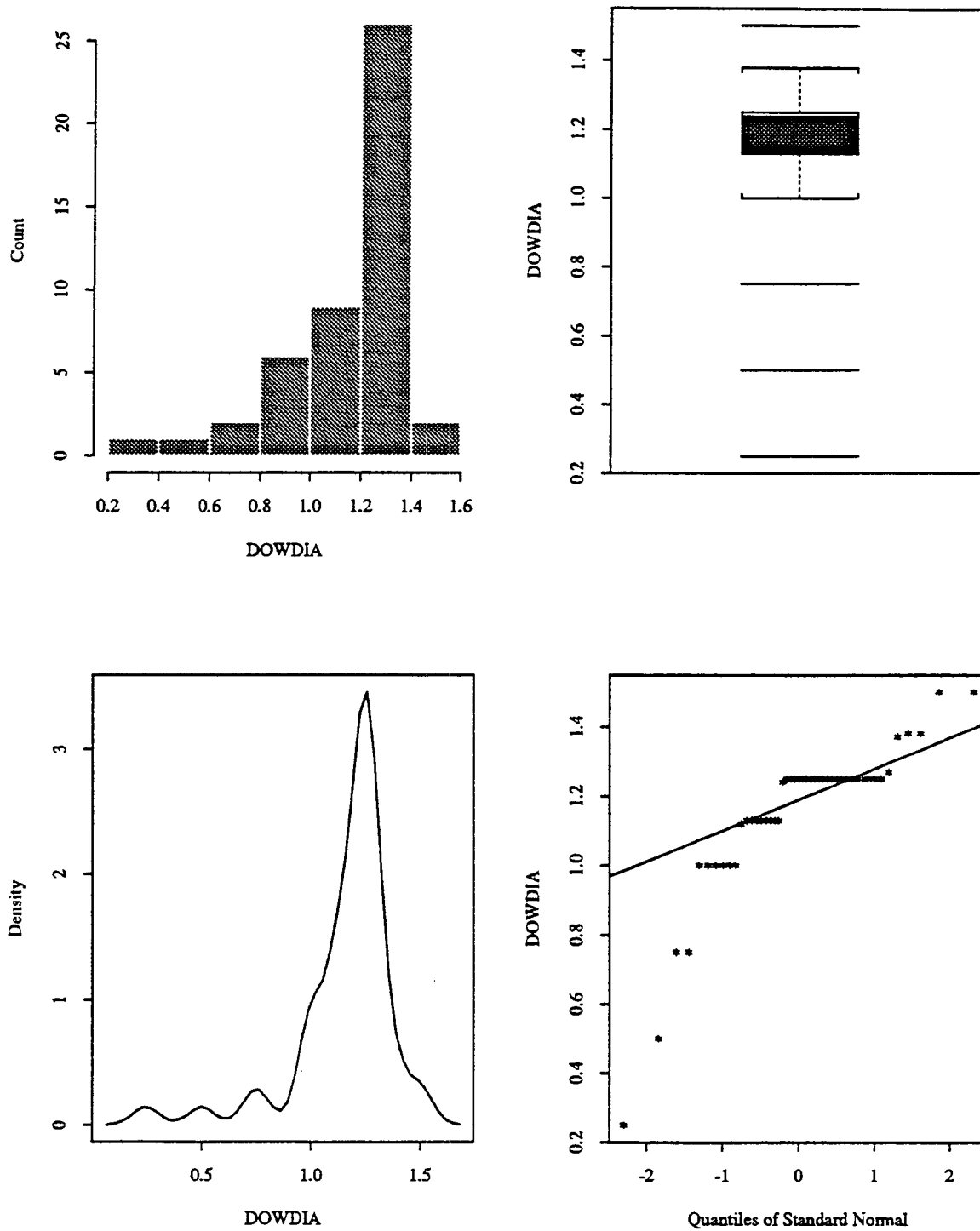


Figure 4.36 Statistical Distribution of Dowel Diameter for GPS-3 Sections

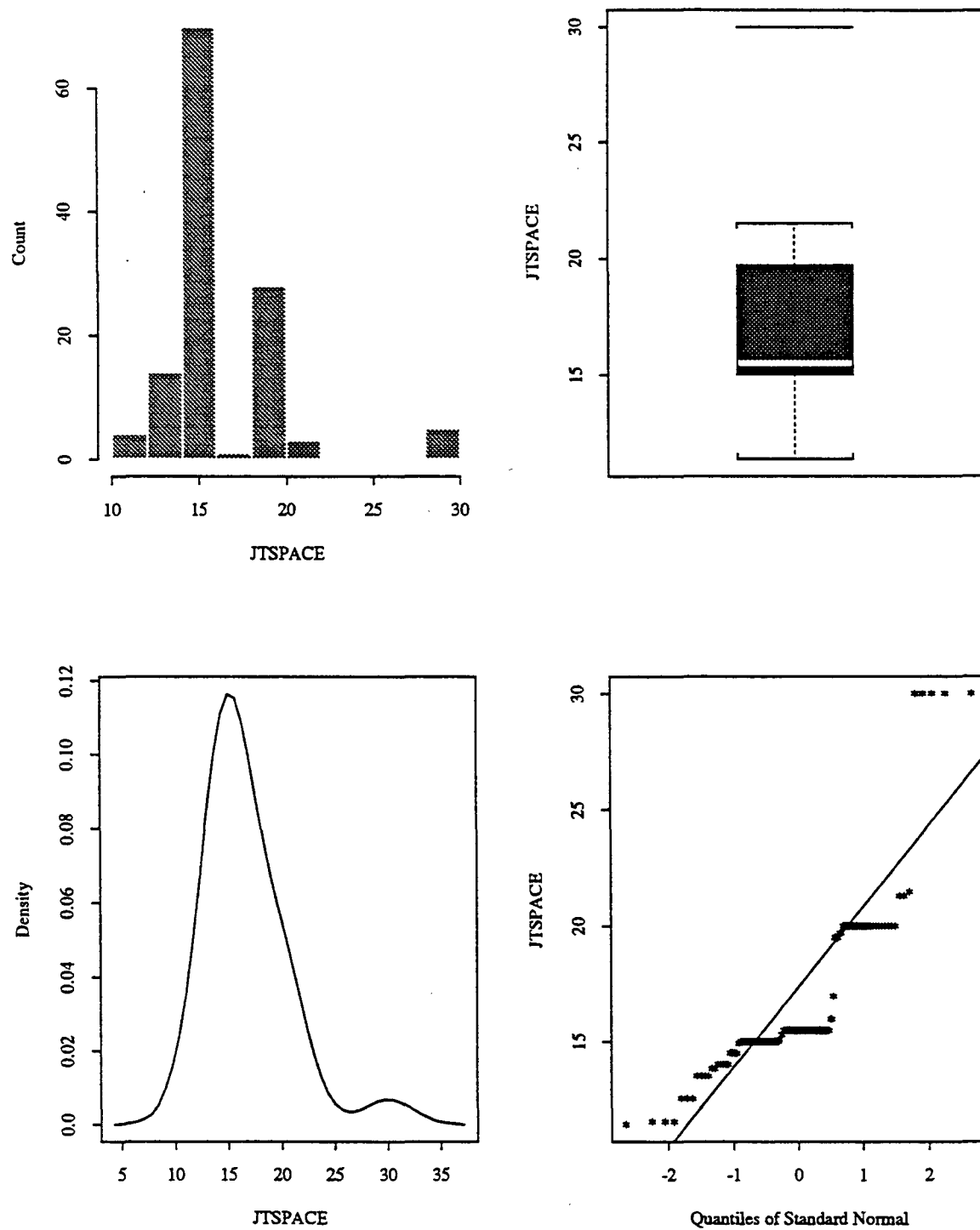


Figure 4.37 Statistical Distribution of Joint Spacing for GPS-3 Sections

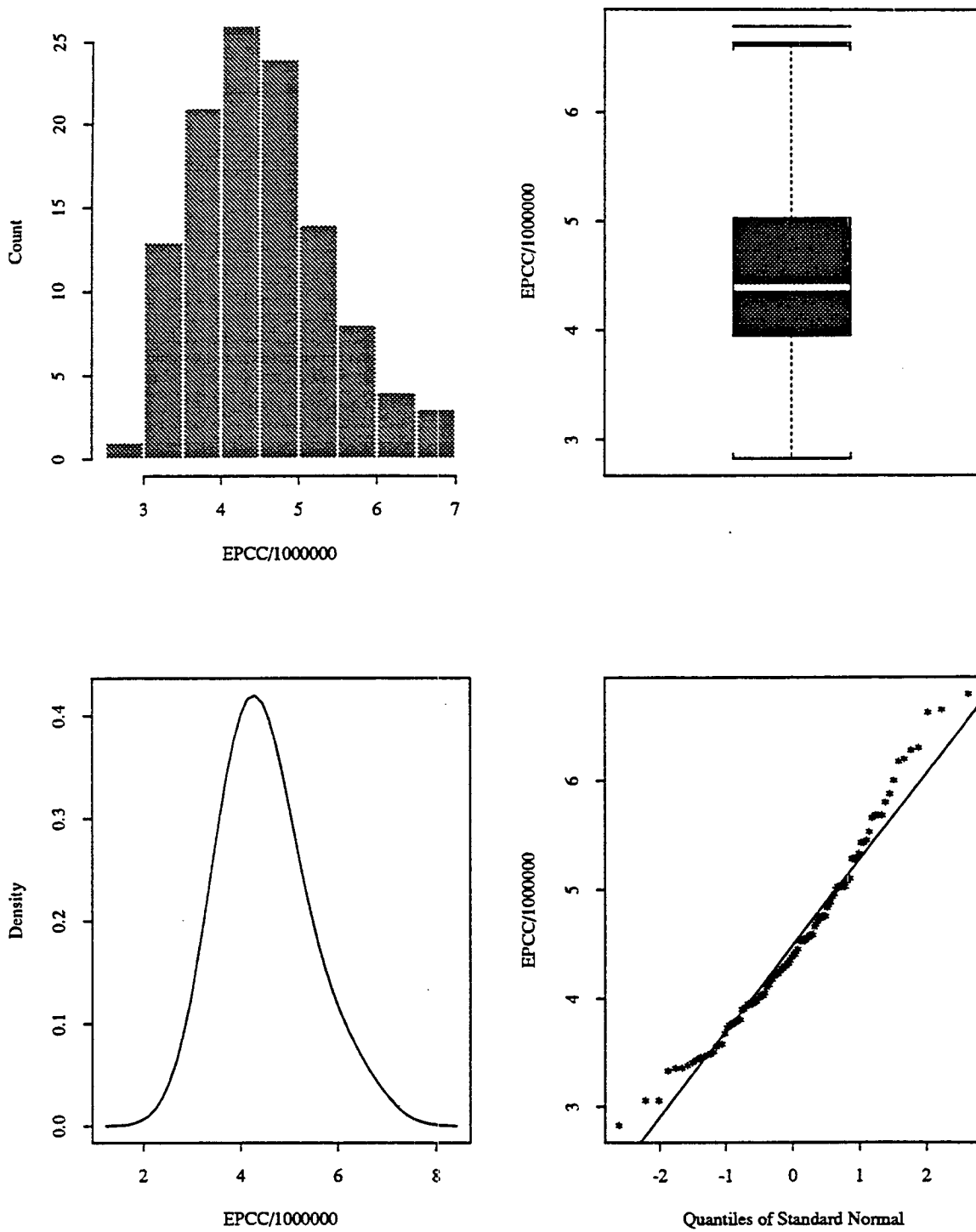


Figure 4.38 Statistical Distribution of PCC Elastic Modulus for GPS-3 Sections

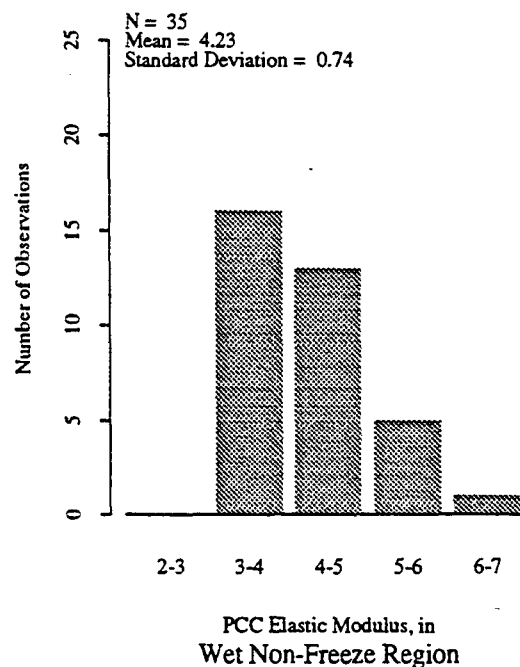
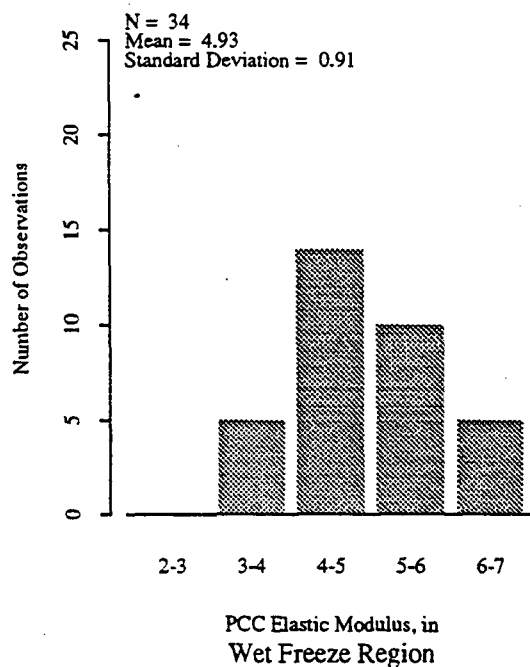
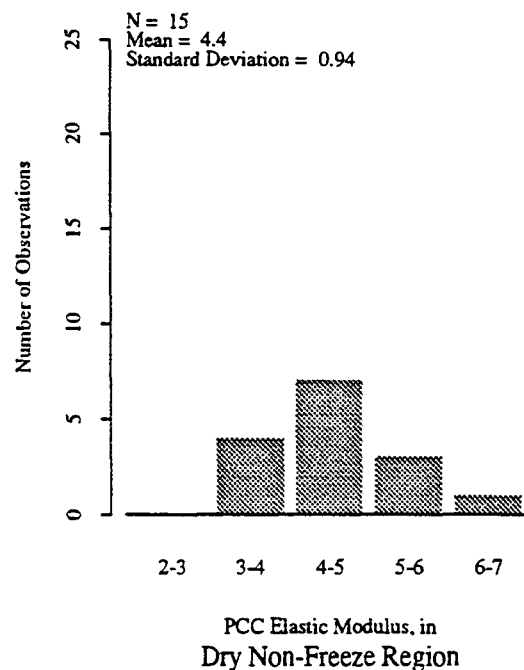
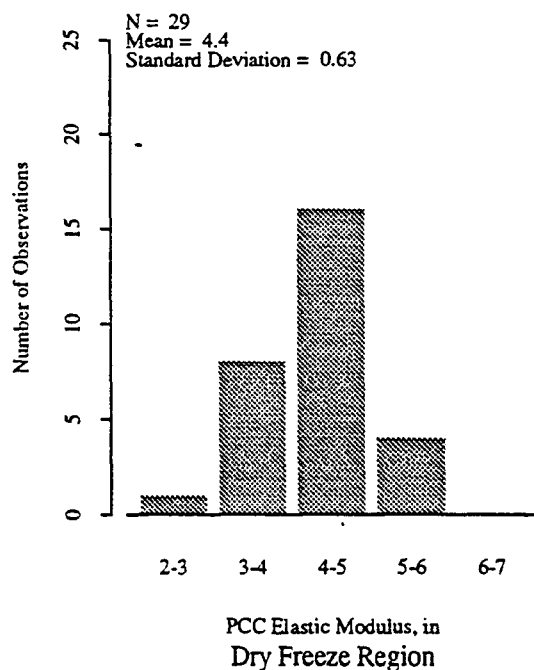


Figure 4.39 Distribution of PCC Elastic Modulus by Environmental Regions for GPS-3 Sections, Million psi

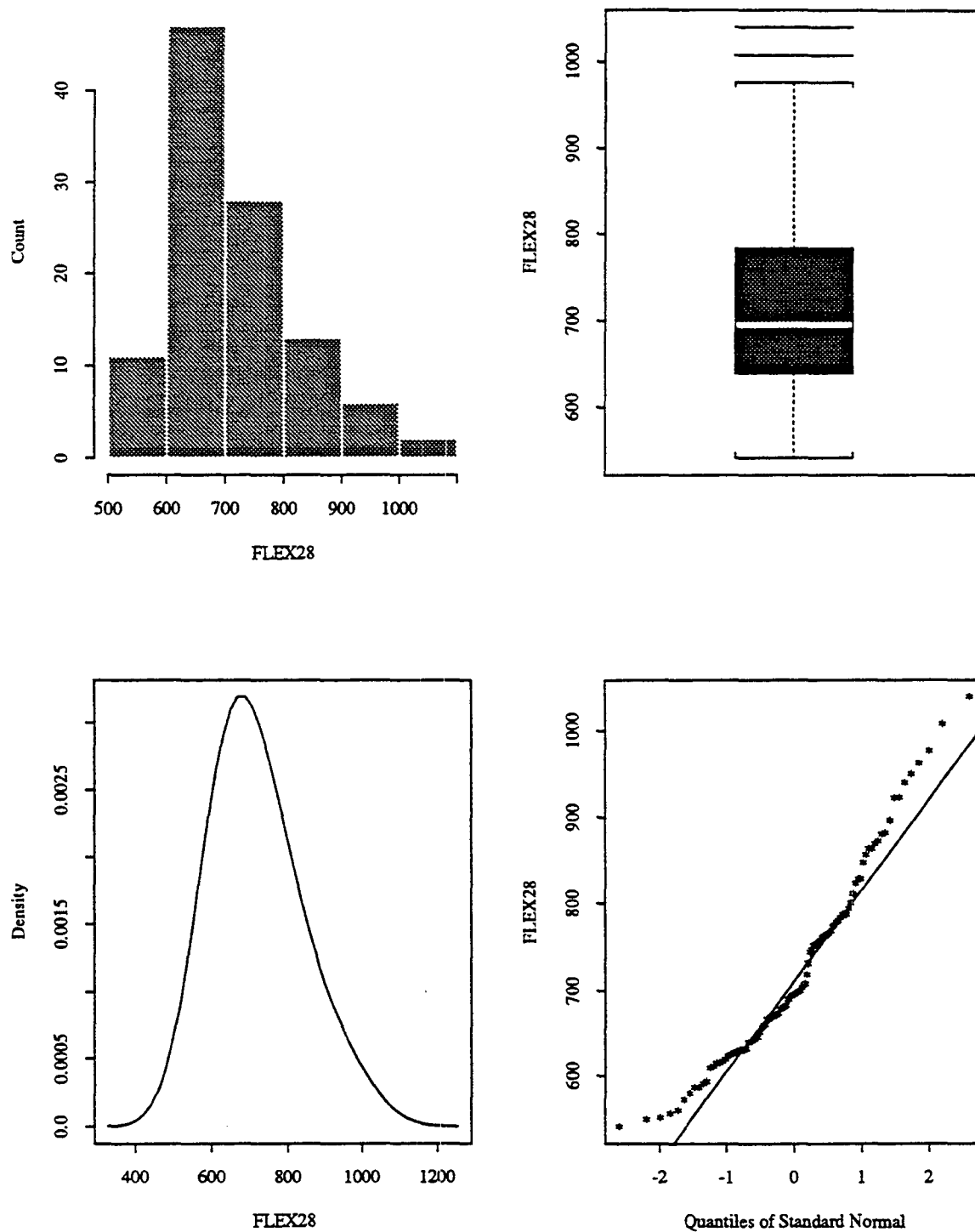


Figure 4.40 Statistical Distribution of 28-Day Flexural Strength for GPS-3 Sections, psi

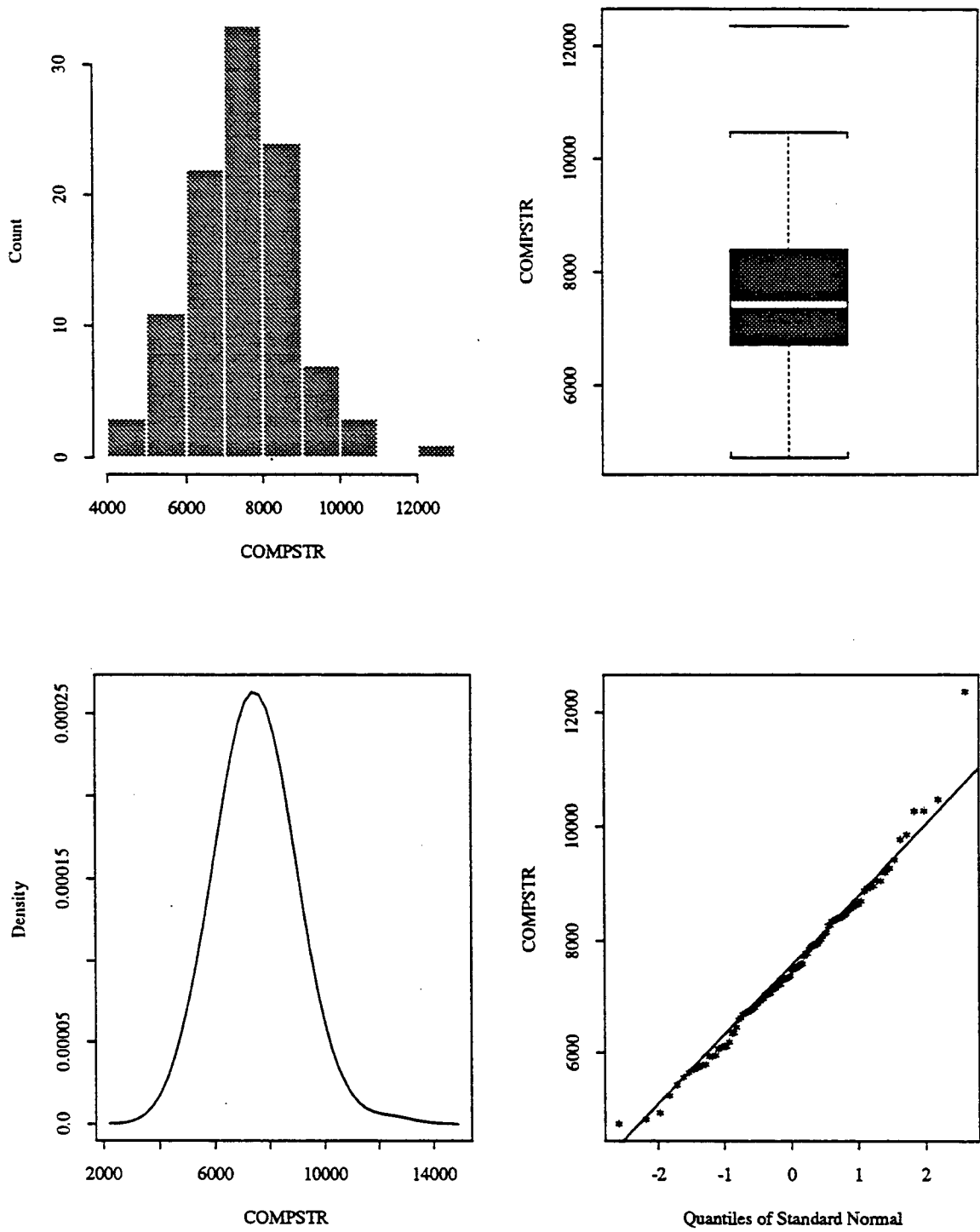


Figure 4.41 Statistical Distribution of Compressive Strength for GPS-3 Sections, psi

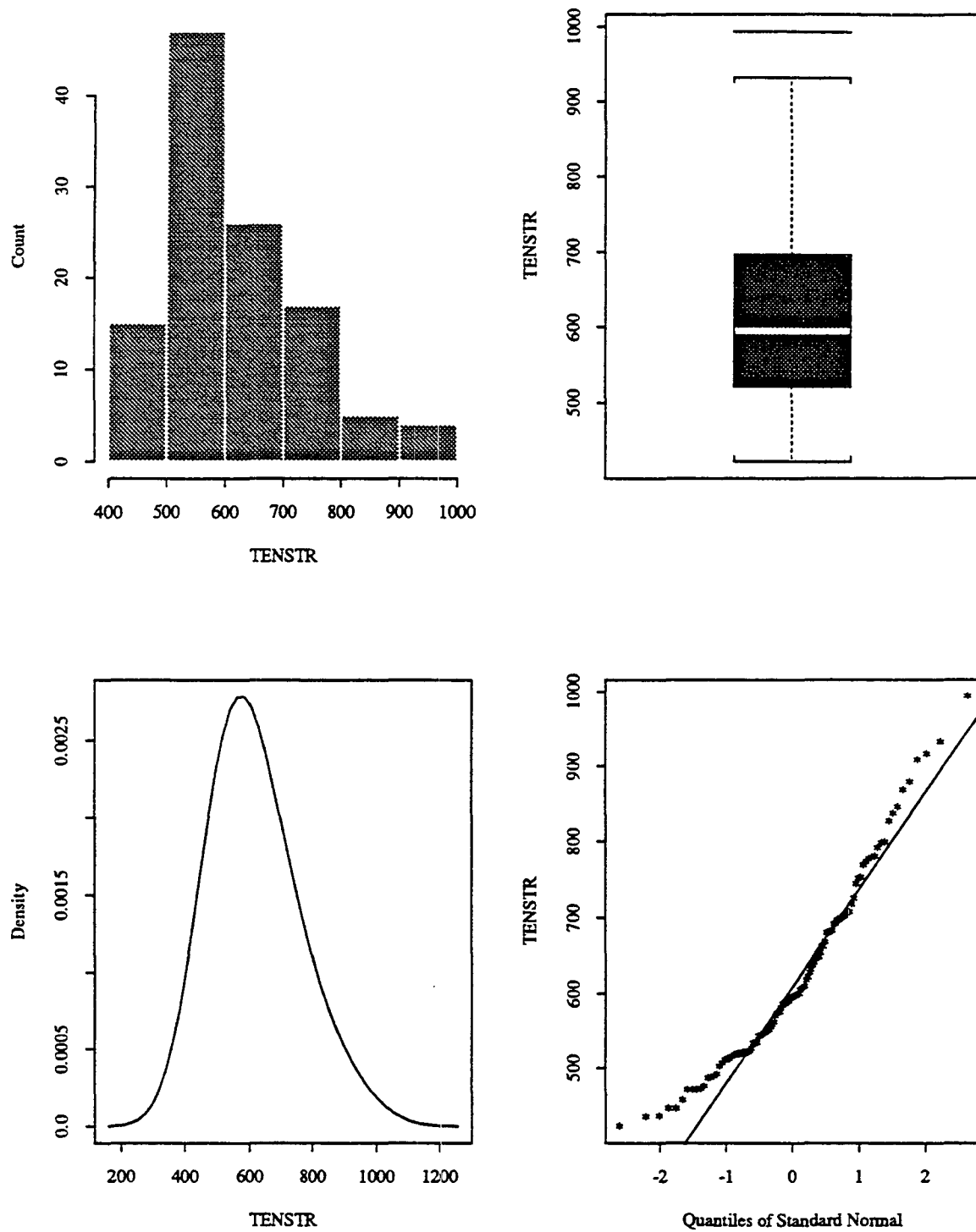


Figure 4.42 Statistical Distribution of Split Tensile Strength for GPS-3 Sections, psi

Statistical Data for GPS-4 Test Sections

Statistical information on the 71 GPS 4 concrete pavement test sections for which data was available is provided in this chapter. The information includes statistical information on the key distress/roughness variables, and the significant variables of interest for the GPS-4 pavement sections. Specifically, they include tables that give information on the number of sections for each variable for which data was available, the mean, standard deviation, the minimum value, the median value, the maximum value, and range of the variable. A table that shows the correlations between the various significant variables, distresses, and roughness is also provided.

In addition, a number of plots are also provided that show the distribution of the various variables, distresses, and roughness. For each significant variable or distress/roughness a histogram, boxplot, probability density plot, and normal quantile-quantile plot are provided. For some of these variables or distresses/roughness, histograms that show their distribution by the four SHRP climatic regions, and scatter plots that show the relationship between the variable or distress/roughness and other selected variables or distresses/roughness, are also provided. For brevity, this latter information is not provided for all the variables or distresses/roughness.

Table 5.1 shows the number of test sections in each cell of the sampling template for the GPS-4 experiment. Environmental factors are defined in Figure 2.2 of Chapter 2. Other factors are summarized as follows:

Traffic Rate:	L - Less than 200 KESAL/Yr. H - Greater than or equal to 200 KESAL/Yr.
Joint Spacing:	L - Less than or equal to 40 ft. (12 m) H - Greater than 40 ft. (12 m)
PCC Thickness:	L - Less than 9.5 inches (240 mm) H - Greater than or equal to 9.5 inches (240 mm)

Table 5.4 relates the variable names used in the correlation table and statistical plots to variable descriptions.

Table 5.1 Number of Test Sections in Each Cell of the GPS-4 Sampling Template

Moisture		Wet								Dry							
Temperature		Freeze				No Freeze				Freeze				No Freeze			
Subgrade Type		F		C		F		C		F		C		F		C	
Traffic Rate		L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H
PCC Thickness	Joint Spacing	Number of JRCP Sections in the Data Set															
L	L	2	3	3	3					1		1	1	-	-	-	-
	H	2	63	2	2	3	2		2	1	2			-	-	-	-
H	L		2	3	2	2	1				2			-	-	-	-
	H	2	3	1	1	2	3		1					-	-	-	-

Table 5.2 Statistical Values for Distress/Roughness Variables in the GPS-4 Data Set.

Variable	Units	Sections With distress	Mean	Standard Deviation	Low Value	Median Value	High Value	Range
Faulting	Inches	32	0.039	0.052	-0.01	0.02	0.18	0.19
Spalling: Low Severity: Moderate Severity: High Severity:	No. Spalls	42	4.4	4.8	0	3	25	25
	Lin. Ft.	63	9.98	19.32	0.00	3.12	119.60	119.60
	No. Spalls	42	0.7	1.6	0	0	8	8
	Lin. Ft.	63	3.88	18.21	0.00	0.00	139.90	139.90
	No. Spalls	42	0.1	0.5	0	0	2	2
	Lin. Ft.	63	1.29	6.41	0.00	0.00	47.67	47.67
Transverse Cracking: Low Severity: Medium Severity: High Severity:	No. Cracks	39	6.5	9.8	0	2	42	42
	Lin. Ft.	54	42.53	98.59	0.00	0.00	571.30	571.30
	No. Cracks	39	2.3	3.9	0	1	16	16
	Lin. Ft.	54	17.37	36.64	0.00	0.00	163.30	163.30
	No. Cracks	39	1.1	3.0	0	0	15	15
	Lin. Ft.	54	9.15	32.54	0.00	0.00	187.00	187.00
Roughness(IRI)	Inches/Mile	70	111.90	28.48	48.61	108.10	198.40	149.79

Table 5.3. Statistical Values of Interest for Significant Variables in the GPS-4 Data Set

Variable	Units	No. of Values	Mean Value	Standard Deviation	Low Value	Median Value	High Value	Range
PCC Thickness	Inches	56	9.39	0.83	7.38	9.43	11.35	3.97
Base Thickness	Inches	70	5.45	3.00	0.00	5.10	18.00	18.00
Subbase Thickness	Inches	70	1.84	3.35	0.00	0.00	12.00	12.00
KESALs per Year	No.	64	348.1	311.5	34.2	229.3	1326.0	1291.8
Pavement Age	Years	52	12.53	5.72	1.93	12.89	24.76	22.83
Air Freeze-Thaw Cycles	No.	71	80.1	24.2	12	88	140	128
Freezing Index	Degree Days	71	733.5	696.49	8	562	3483	3475
No. of Days Temp. > 90°F	No.	71	29.97	24.16	1	23	88	87
No. of Days Temp. < 32°F	No.	71	106.30	42.72	10	111	193	183
Average Min. Temp. by Month	°F	70	15.76	11.19	-13.11	15.84	38.61	51.72
Average Max. Temp. by Month	°F	70	88.08	4.34	79.22	88.50	95.26	18.04
Average Monthly Precipitation	Inches	71	3.40	0.82	1.42	3.30	5.66	4.24
Average Yearly Precipitation	Inches	71	40.78	9.88	17.10	39.50	67.90	50.80
Wet Days in Year	No.	71	129.8	24.9	71	129	199	128

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Table 5.3. Statistical Values of Interest for Significant Variables in the GPS-4 Data Set

Variable	Units	No. of Values	Mean Value	Standard Deviation	Low Value	Median Value	High Value	Range
Dowel Diameter	Inches	68	1.15	0.20	0.25	1.25	1.50	1.25
Dowel Length	Inches	66	18.44	2.46	14	18	30	16
Dowel Spacing	Inches	54	6.46	1.98	0.6	6.0	12.0	11.4
Joint Spacing	Feet	71	48.8	17.2	0.0	45.6	100.0	100.0
Subgrade Soil Passing #200	Percent	62	55.43	30.83	1.4	57.2	97.6	96.2
Backcalculated Static k-value	pci	54	127.10	81.85	47.68	99.52	458.50	410.82
PCC Elastic Modulus	$\times 10^6$, psi	57	4.76	0.78	3.50	4.73	6.35	2.85
PCC 28-day Flexural Strength	psi	56	751.6	104.6	569	743	1081	512
PCC Compressive Strength	psi	57	7762	1304	3960	7745	11450	7490
PCC Indirect Tensile Strength	psi	57	664.5	119.5	462	652	1050	588

Table 5.4 Nomenclature Used for Correlation Table and Statistical Plots

Variable	Description of Variable
FAULT	Faulting, inches
TSPALLNO	Total number of spalled joints (all severities)
SPALL.H.NO	Number of high severity spalled joints
SPALL.M.NO	Number of low severity spalled joints
SPALL.L.NO	Number of low severity spalled joints
TSPALLFT	Total measured joint spalling (all severities) in linear feet
SPALL.H.FT	Measured high severity spalling in linear feet
SPALL.M.FT	Measured medium severity spalling in linear feet
SPALL.L.FT	Measured low severity spalling in linear feet
TCRACKNO	Total number of transverse cracks (all severities)
TCRACK.H.NO	Number of high severity transverse cracks
TCRACK.M.NO	Number of medium severity transverse cracks
TCRACK.L.NO	Number of low severity transverse cracks
TCRACKFT	Total measured transverse cracking (all severities) in linear feet
TCRACK.H.FT	Measured high severity transverse cracking in linear feet
TCRACK.M.FT	Measured medium severity transverse cracking in linear feet
TCRACK.L.FT	Measured low severity transverse cracking in linear feet
AVE.IRI or IRI	Measured average IRI value, inches/mile
AVE.SV	Measured average slope variance
THICK	Measured PCC layer thickness, inches
BASETHK	Measured base thickness, inches
SBASETHK	Measured subbase thickness, inches
YRL.KESAL or YRKESAL	Cumulative 18-kip ESALs per year, thousands
AGE	Pavement age, years

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Table 5.4 Nomenclature Used for Correlation Table and Statistical Plots

Variable	Description of Variable
FT	Average number of air freeze-thaw cycles
FI	Freezing index, degree days
DAYS90	Number of days with temperature greater than 90°F
DAYS32	Number of days with temperature lower than 32°F
MAXTEMP	Average monthly maximum temperature, °F
MINTEMP	Average monthly minimum temperature, °F
YRL.PRECIP or YRPRECIP	Average precipitation by year, inches
PRECIP	Average precipitation by month, inches
DAYSWET	Average number of wet days
DOWDIA	Dowel diameter, inches
JTSPACE	Joint Spacing, feet
PM200	Subgrade soil passing the #200 sieve, percent by weight
KSTATIC	Backcalculated modulus of subgrade reaction, psi/inch
EPCC	Measured PCC layer elastic modulus, psi
FLEX28	PCC layer 28-day flexural strength, psi
COMPSTR	PCC layer compressive strength, psi
TENSTR	PCC layer indirect (split) tensile strength, psi

Table 5.5 Correlation Matrix for Significant Variables in the GPS-4 Data Set

	FAULT	TSPALLNO	TSPALLFT	TCRACKNO	TCRACKFT	IRI	THICK	BASETHK	SBASETHK	KSTATIC	YRKESAL	FT
FAULT	1.000	-0.248	-0.192	0.818	0.798	0.598	0.363	0.350	0.522	-0.501	0.345	-0.306
TSPALLNO	-0.248	1.000	0.990	-0.136	-0.139	0.220	0.277	-0.487	0.029	0.222	-0.289	-0.496
TSPALLFT	-0.192	0.990	1.000	-0.061	-0.058	0.323	0.327	-0.461	0.089	0.182	-0.325	-0.486
TCRACKNO	0.818	-0.136	-0.061	1.000	0.997	0.860	0.482	0.416	0.616	-0.749	0.381	-0.316
TCRACKFT	0.798	-0.139	-0.058	0.997	1.000	0.873	0.470	0.392	0.608	-0.762	0.345	-0.267
IRI	0.598	0.220	0.323	0.860	0.873	1.000	0.528	0.159	0.532	-0.628	0.177	-0.327
THICK	0.363	0.277	0.327	0.482	0.470	0.528	1.000	0.276	0.911	0.102	0.200	-0.676
BASETHK	0.350	-0.487	-0.461	0.416	0.392	0.159	0.276	1.000	0.532	-0.026	0.090	-0.389
SBASETHK	0.522	0.029	0.089	0.616	0.608	0.532	0.911	0.532	1.000	0.011	0.114	-0.600
KSTATIC	-0.501	0.222	0.182	-0.749	-0.762	-0.628	0.102	-0.026	0.011	1.000	-0.454	-0.196
YRKESAL	0.345	-0.289	-0.325	0.381	0.345	0.177	0.200	0.090	0.114	-0.454	1.000	-0.132
FT	-0.306	-0.496	-0.486	-0.316	-0.267	-0.327	-0.676	-0.389	-0.600	-0.196	-0.132	1.000
FI	-0.437	-0.242	-0.293	-0.392	-0.362	-0.501	-0.684	-0.501	-0.683	-0.188	-0.099	0.781
MAXTEMP	0.509	0.278	0.277	0.382	0.336	0.340	0.807	0.230	0.704	0.145	0.449	-0.817
MINTEMP	0.406	0.382	0.405	0.377	0.335	0.435	0.709	0.481	0.676	0.204	0.110	-0.942
DAYS90	0.425	0.369	0.348	0.324	0.269	0.262	0.726	0.296	0.625	0.185	0.362	-0.935
DAYS32	-0.395	-0.402	-0.421	-0.377	-0.334	-0.430	-0.723	-0.464	-0.678	-0.199	-0.130	0.957
YRPRECIP	0.669	0.238	0.293	0.515	0.488	0.505	0.633	0.475	0.716	0.101	-0.118	-0.774
PRECIP	0.669	0.239	0.293	0.515	0.488	0.505	0.633	0.475	0.716	0.101	-0.115	-0.776
DOWDIA	-0.630	0.161	0.164	-0.179	-0.143	0.050	0.053	-0.300	-0.100	-0.081	0.125	0.311
JTSPACE	0.476	0.282	0.293	0.283	0.253	0.411	0.260	-0.286	0.074	-0.204	0.549	-0.328
PM200	-0.177	0.366	0.350	-0.272	-0.293	0.039	-0.102	-0.350	-0.354	0.141	0.281	-0.140
EPCC	0.391	0.125	0.114	0.446	0.420	0.247	0.775	0.365	0.845	0.045	0.288	-0.637
DAYSWET	0.189	0.344	0.445	0.381	0.427	0.621	0.067	-0.084	0.157	-0.310	-0.612	0.045

Table 5.5 Correlation Matrix for Significant Variables in the GPS-4 Data Set

	FI	MAXTEMP	MINTEMP	DAYS90	DAYS32	YRPRECIP	PRECIP	DOWDIA	JTSPACE	PM200	EPCC	DAYSWET
FAULT	-0.437	0.509	0.406	0.425	-0.395	0.669	0.669	-0.630	0.476	-0.177	0.391	0.189
TSPALLNO	-0.242	0.278	0.382	0.369	-0.402	0.238	0.239	0.161	0.282	0.366	0.125	0.344
TSPALLFT	-0.293	0.277	0.405	0.348	-0.421	0.293	0.293	0.164	0.293	0.350	0.114	0.445
TCRACKNO	-0.392	0.382	0.377	0.324	-0.377	0.515	0.515	-0.179	0.283	-0.272	0.446	0.381
TCRACKFT	-0.362	0.336	0.335	0.269	-0.334	0.488	0.488	-0.143	0.253	-0.293	0.420	0.427
IRI	-0.501	0.340	0.435	0.262	-0.430	0.505	0.505	0.050	0.411	0.039	0.247	0.621
THICK	-0.684	0.807	0.709	0.726	-0.723	0.633	0.633	0.053	0.260	-0.102	0.775	0.067
BASETHK	-0.501	0.230	0.481	0.296	-0.464	0.475	0.475	-0.300	-0.286	-0.350	0.365	-0.084
SBASETHK	-0.683	0.704	0.676	0.625	-0.678	0.716	0.716	-0.100	0.074	-0.354	0.845	0.157
KSTATIC	-0.188	0.145	0.204	0.185	-0.199	0.101	0.101	-0.081	-0.204	0.141	0.045	-0.310
YRKESAL	-0.099	0.449	0.110	0.362	-0.130	-0.118	-0.115	0.125	0.549	0.281	0.288	-0.612
FT	0.781	-0.817	-0.942	-0.935	0.957	-0.774	-0.776	0.311	-0.328	-0.140	-0.637	0.045
FI	1.000	-0.769	-0.944	-0.744	0.929	-0.842	-0.842	0.264	-0.464	-0.318	-0.476	-0.093
MAXTEMP	-0.769	1.000	0.834	0.953	-0.847	0.705	0.707	-0.273	0.617	0.220	0.748	-0.261
MINTEMP	-0.944	0.834	1.000	0.886	-0.999	0.867	0.868	-0.329	0.415	0.235	0.582	0.033
DAYS90	-0.744	0.953	0.886	1.000	-0.904	0.727	0.729	-0.350	0.503	0.182	0.720	-0.260
DAYS32	0.929	-0.847	-0.999	-0.904	1.000	-0.855	-0.856	0.313	-0.415	-0.227	-0.604	-0.015
YRPRECIP	-0.842	0.705	0.867	0.727	-0.855	1.000	1.000	-0.622	0.324	-0.054	0.528	0.308
PRECIP	-0.842	0.707	0.868	0.729	-0.856	1.000	1.000	-0.622	0.326	-0.053	0.529	0.306
DOWDIA	0.264	-0.273	-0.329	-0.350	0.313	-0.622	-0.622	1.000	-0.186	0.151	-0.070	-0.013
JTSPACE	-0.464	0.617	0.415	0.503	-0.415	0.324	0.326	-0.186	1.000	0.719	0.085	-0.130
PM200	-0.318	0.220	0.235	0.182	-0.227	-0.054	-0.053	0.151	0.719	1.000	-0.348	-0.229
EPCC	-0.476	0.748	0.582	0.720	-0.604	0.528	0.529	-0.070	0.085	-0.348	1.000	-0.143
DAYSWET	-0.093	-0.261	0.033	-0.260	-0.015	0.308	0.306	-0.013	-0.130	-0.229	-0.143	1.000

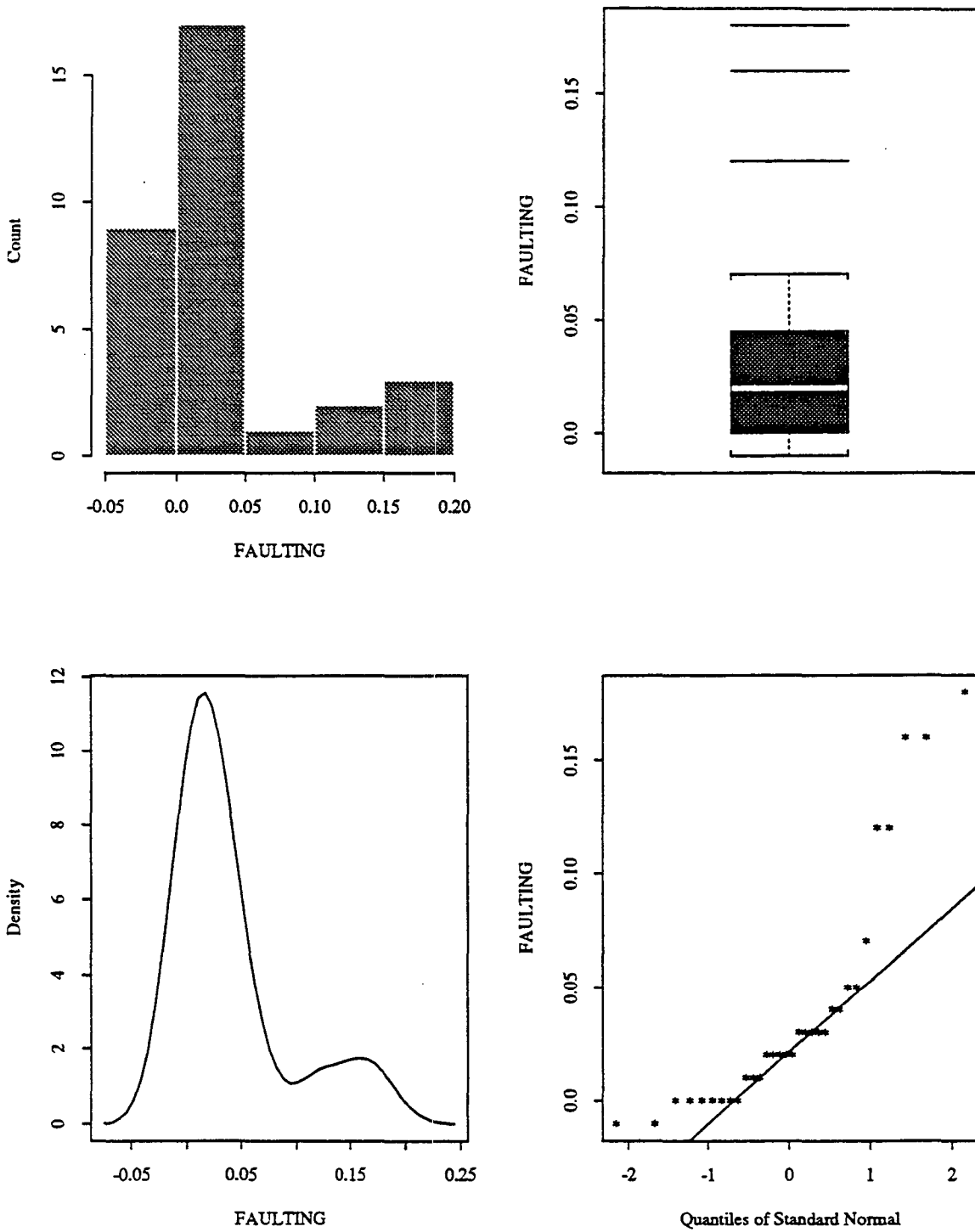


Figure 5.1 Statistical Distribution of Faulting for GPS-4 Sections

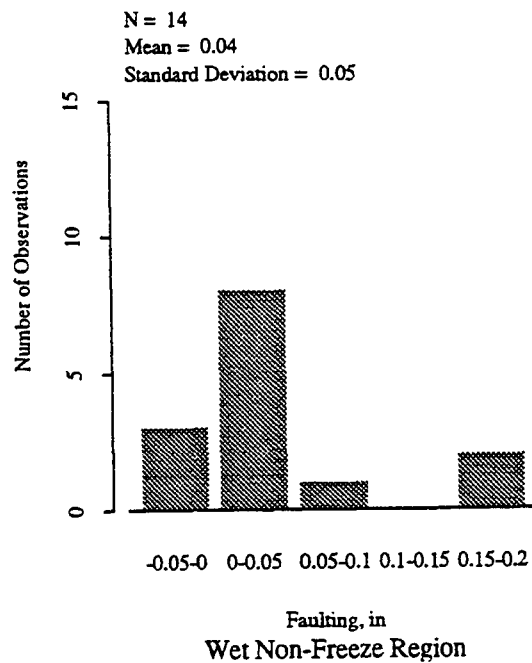
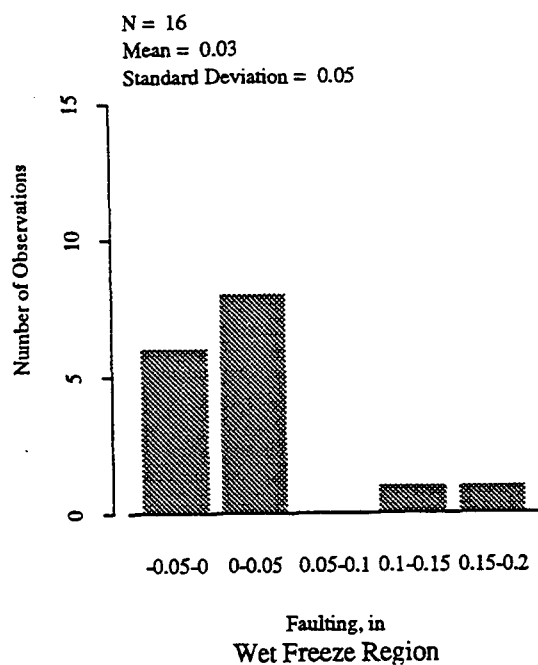


Figure 5.2 Distribution of Faulting by Environmental Regions for GPS-4 Sections

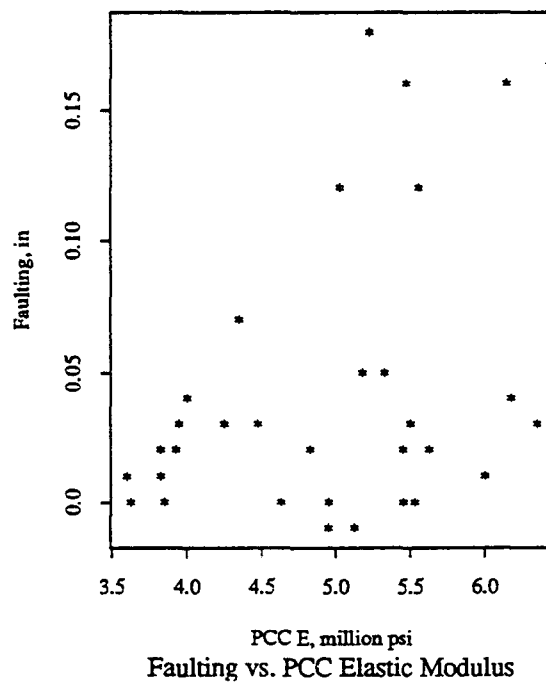
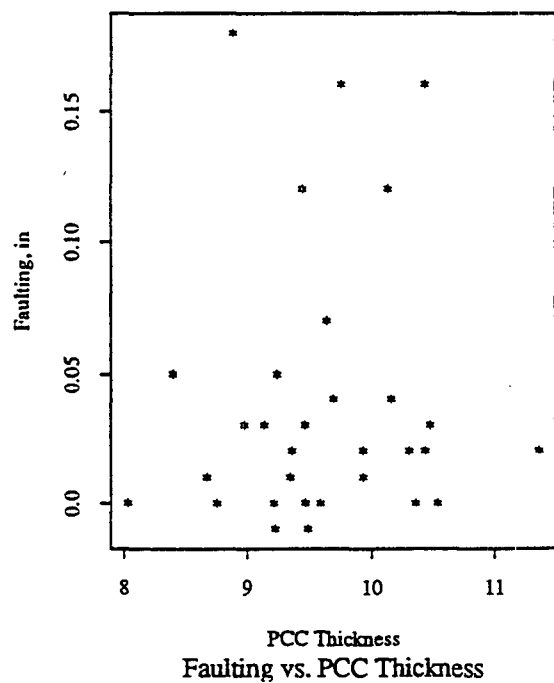
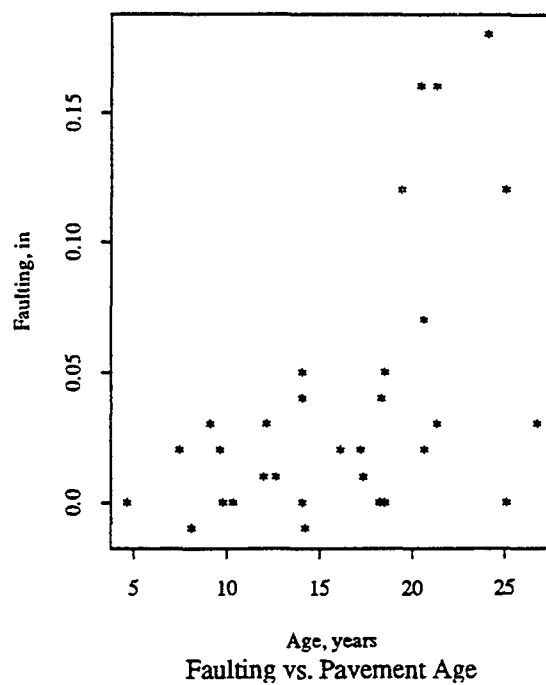
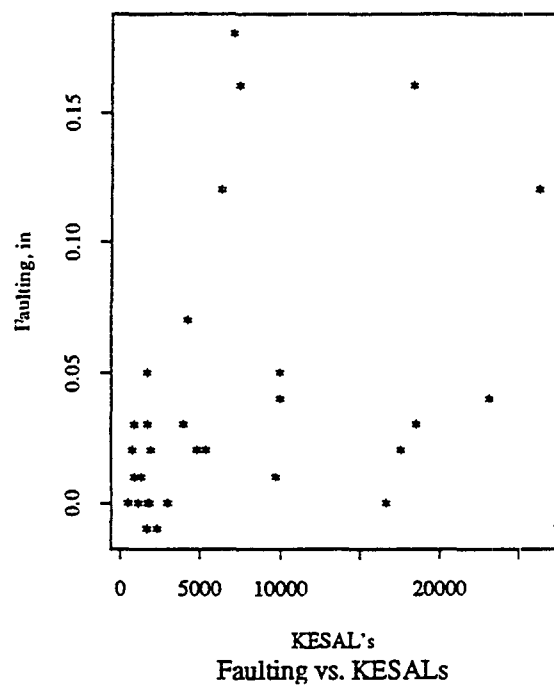


Figure 5.3 Faulting Scatter Plots for GPS-4 Sections

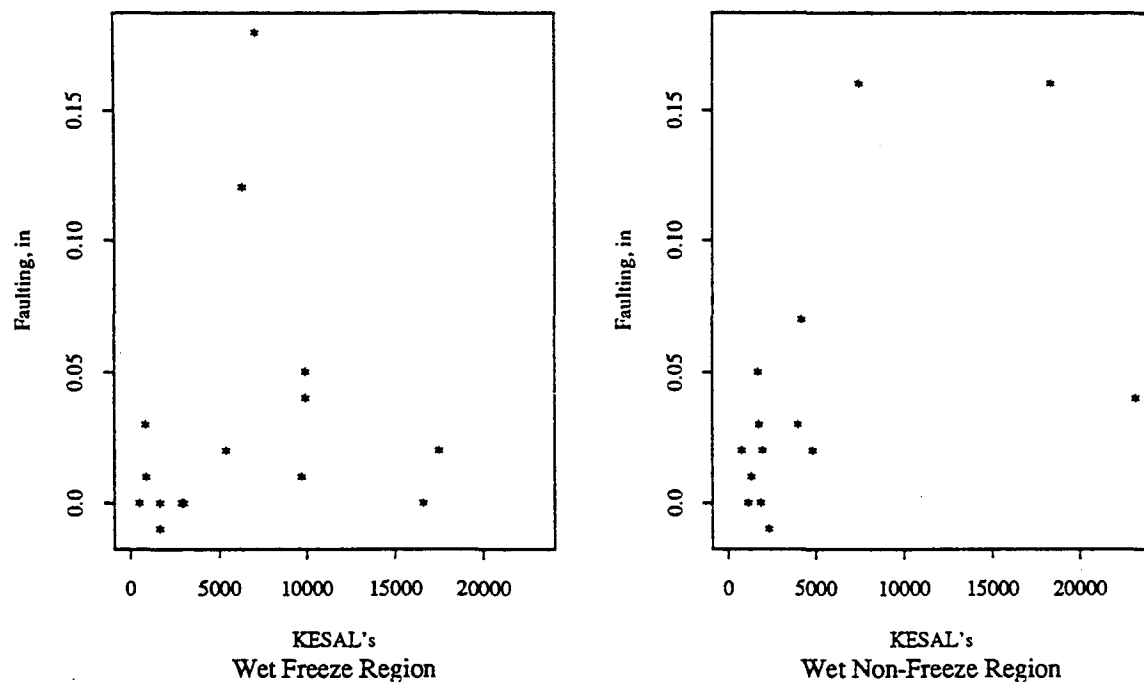


Figure 5.4 Faulting vs. KESALs Scatter Plots for GPS-4 Sections

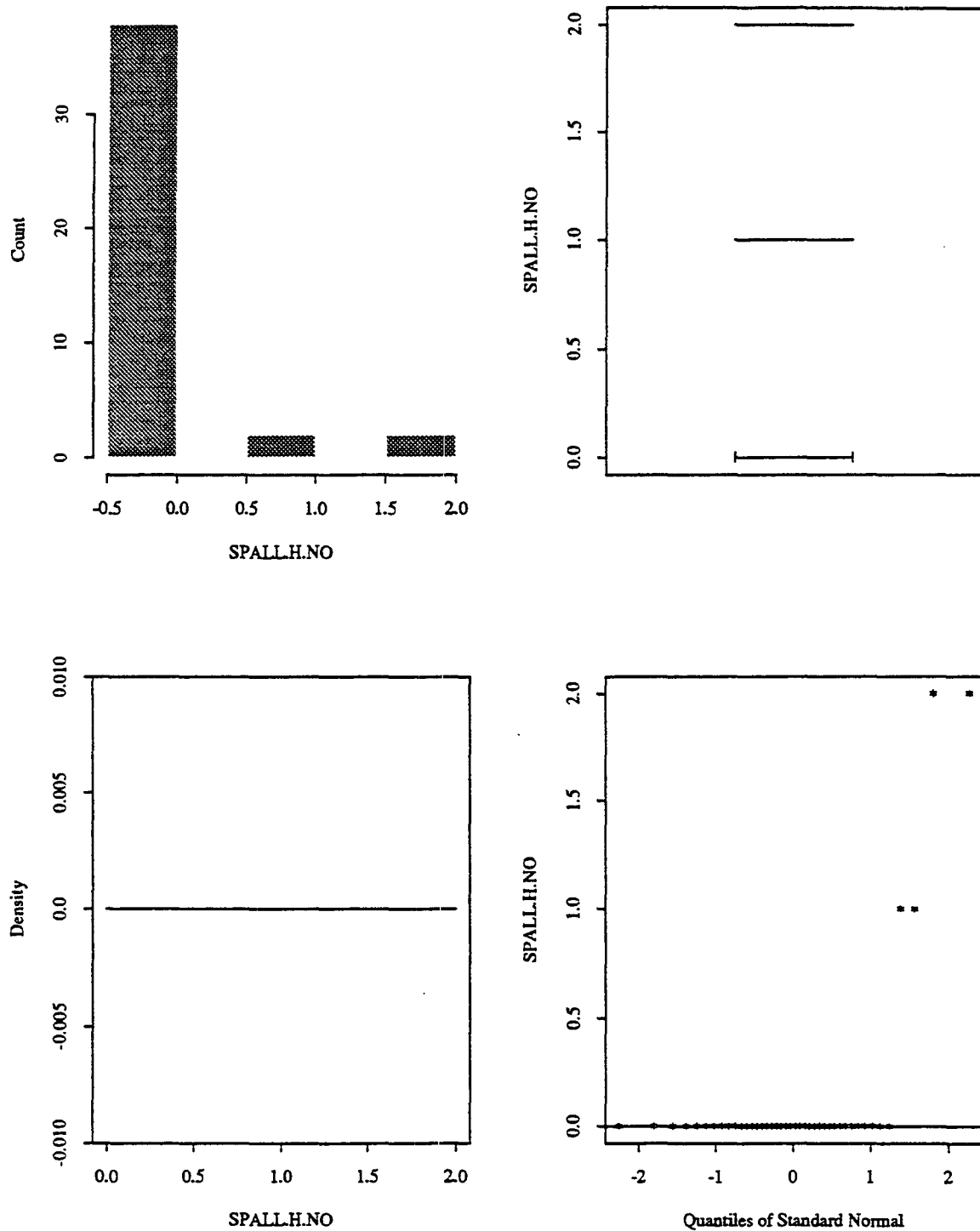


Figure 5.5 Statistical Distribution of High Severity Spalling for GPS-4 Sections, Number

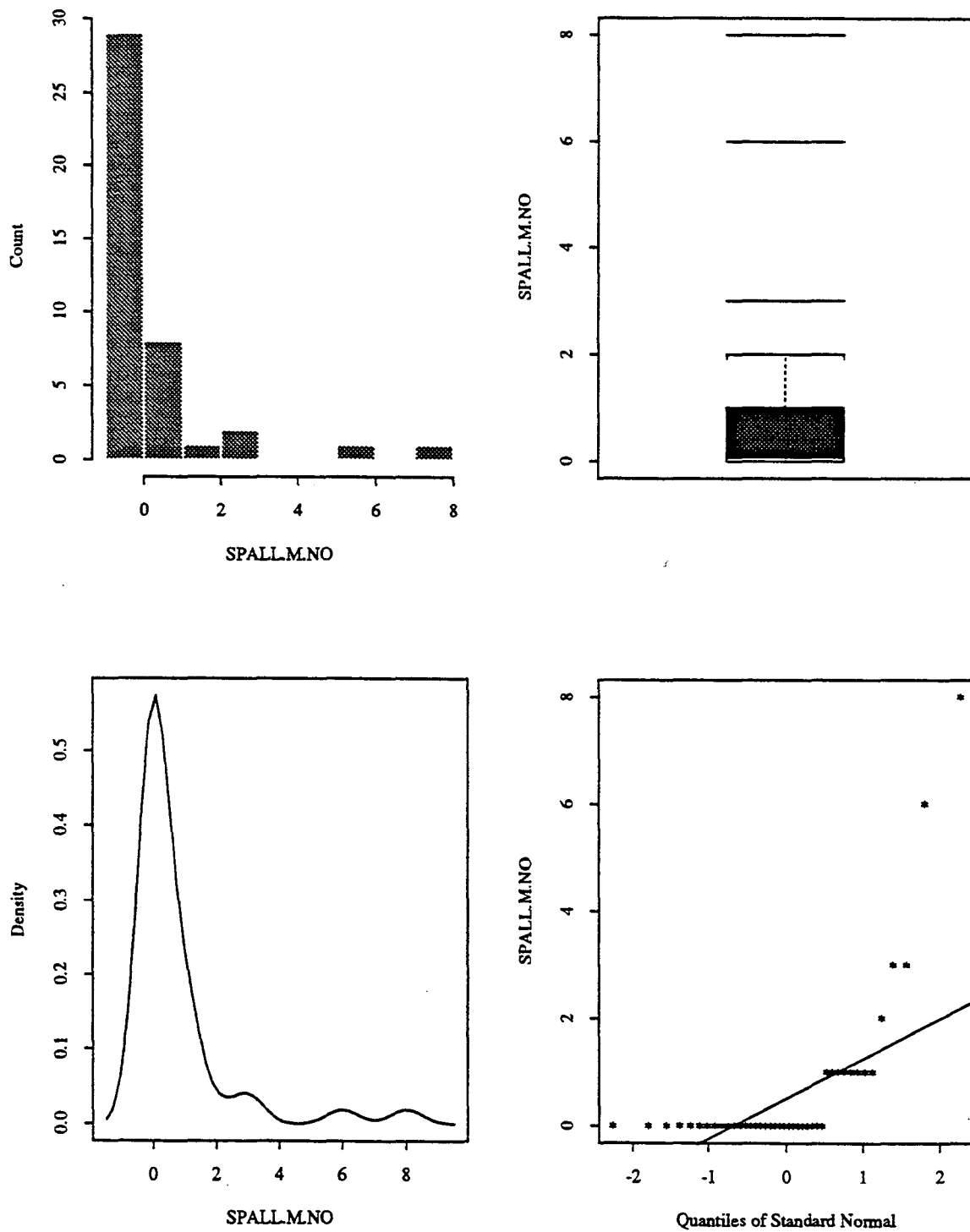


Figure 5.6 Statistical Distribution of Medium Severity Spalling for GPS-4 Sections, Number

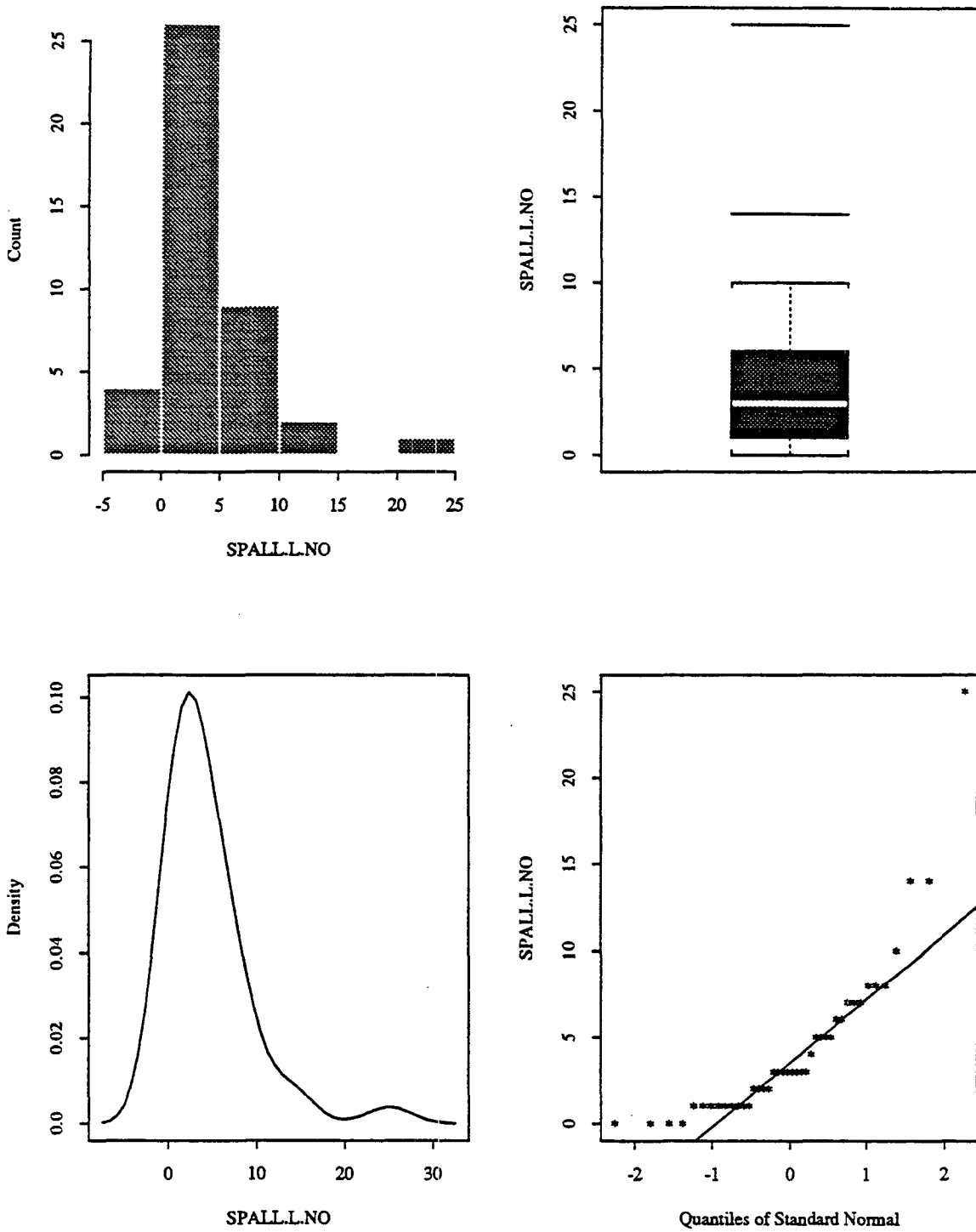


Figure 5.7 Statistical Distribution of Low Severity Spalling for GPS-4 Sections, Number

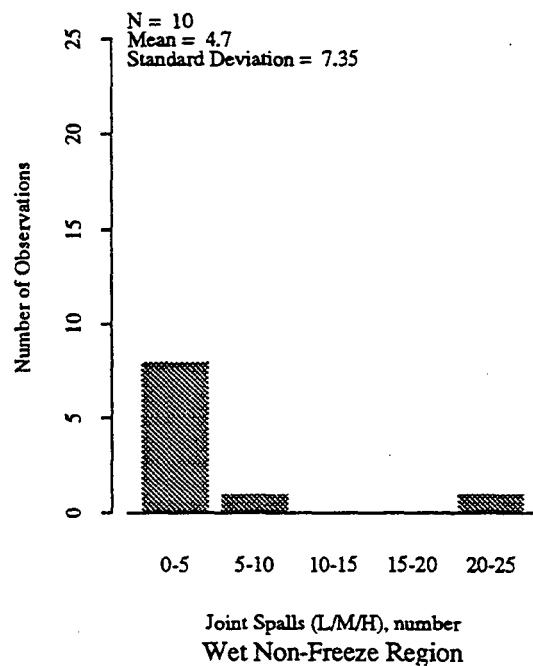
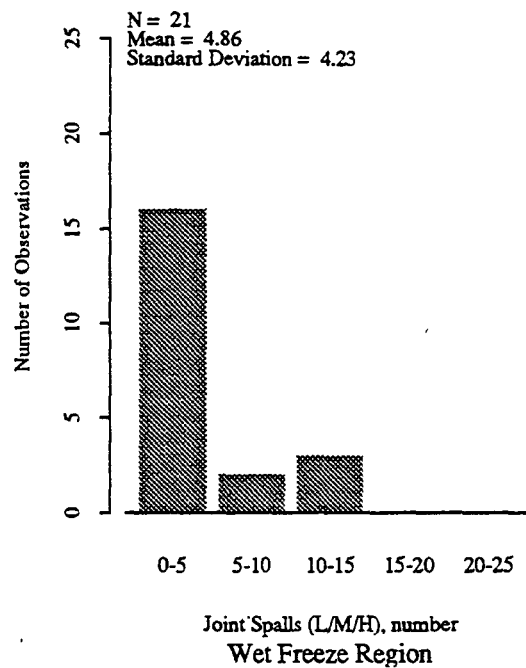
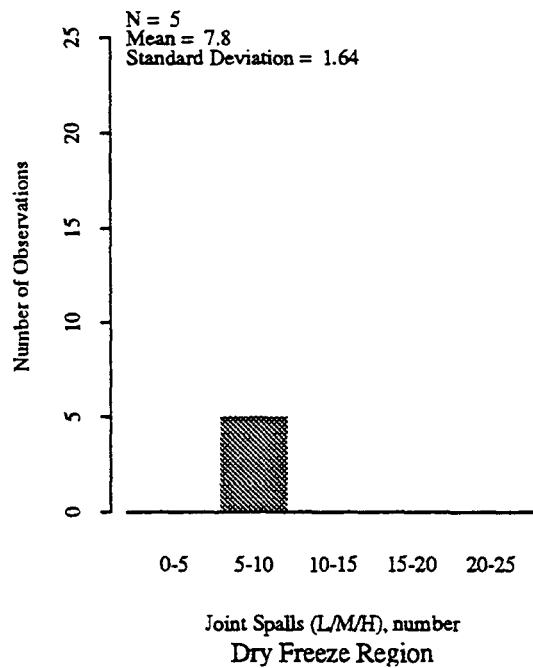


Figure 5.8 Distribution of Joint Spalling by Environmental Regions for GPS-4 Sections

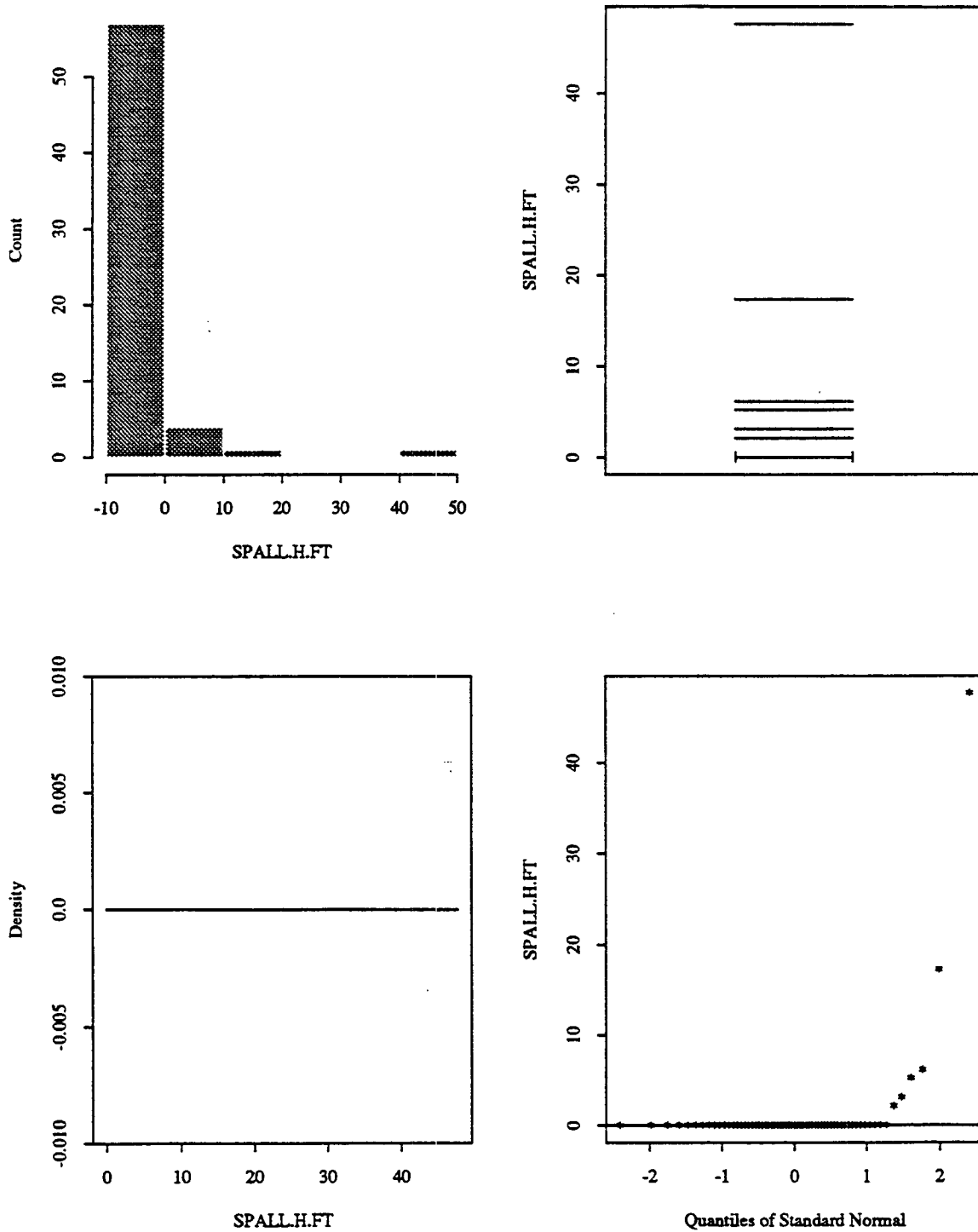


Figure 5.9 Statistical Distribution of High Severity Spalling for GPS-4 Sections, Ft.

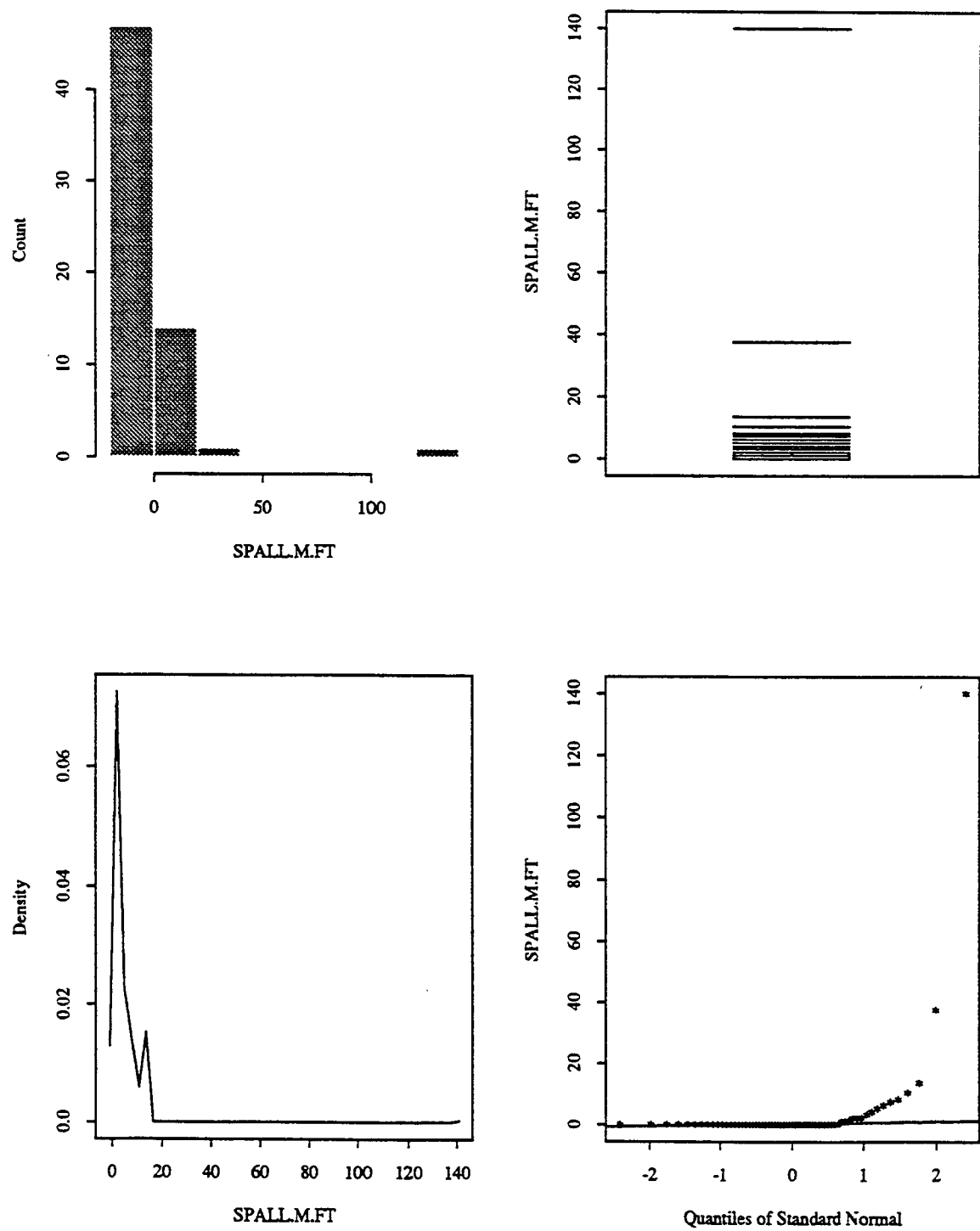


Figure 5.10 Statistical Distribution of Medium Severity Spalling for GPS-4 Sections, Ft.

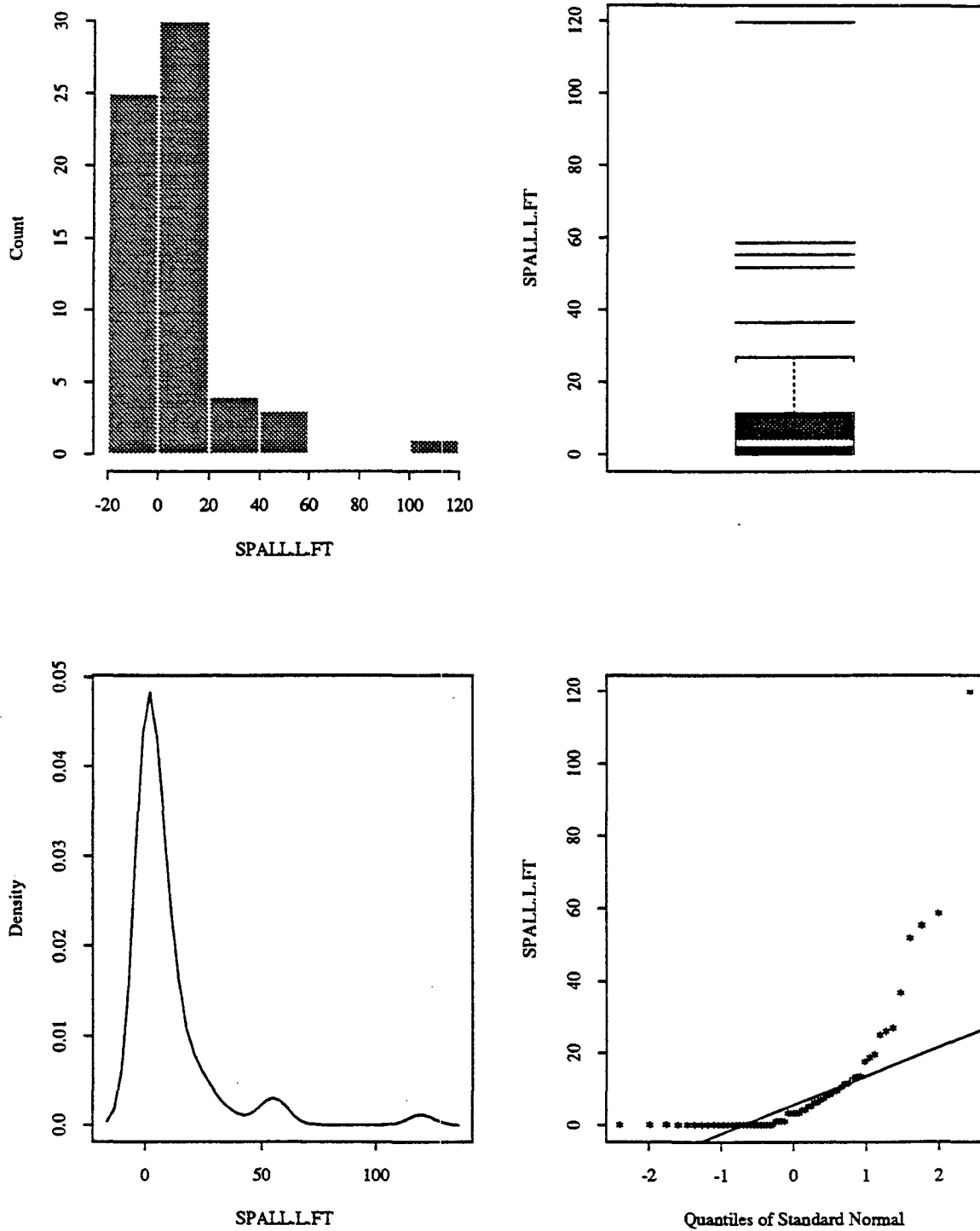


Figure 5.11 Statistical Distribution of Low Severity Spalling for GPS-4 Sections, Ft.

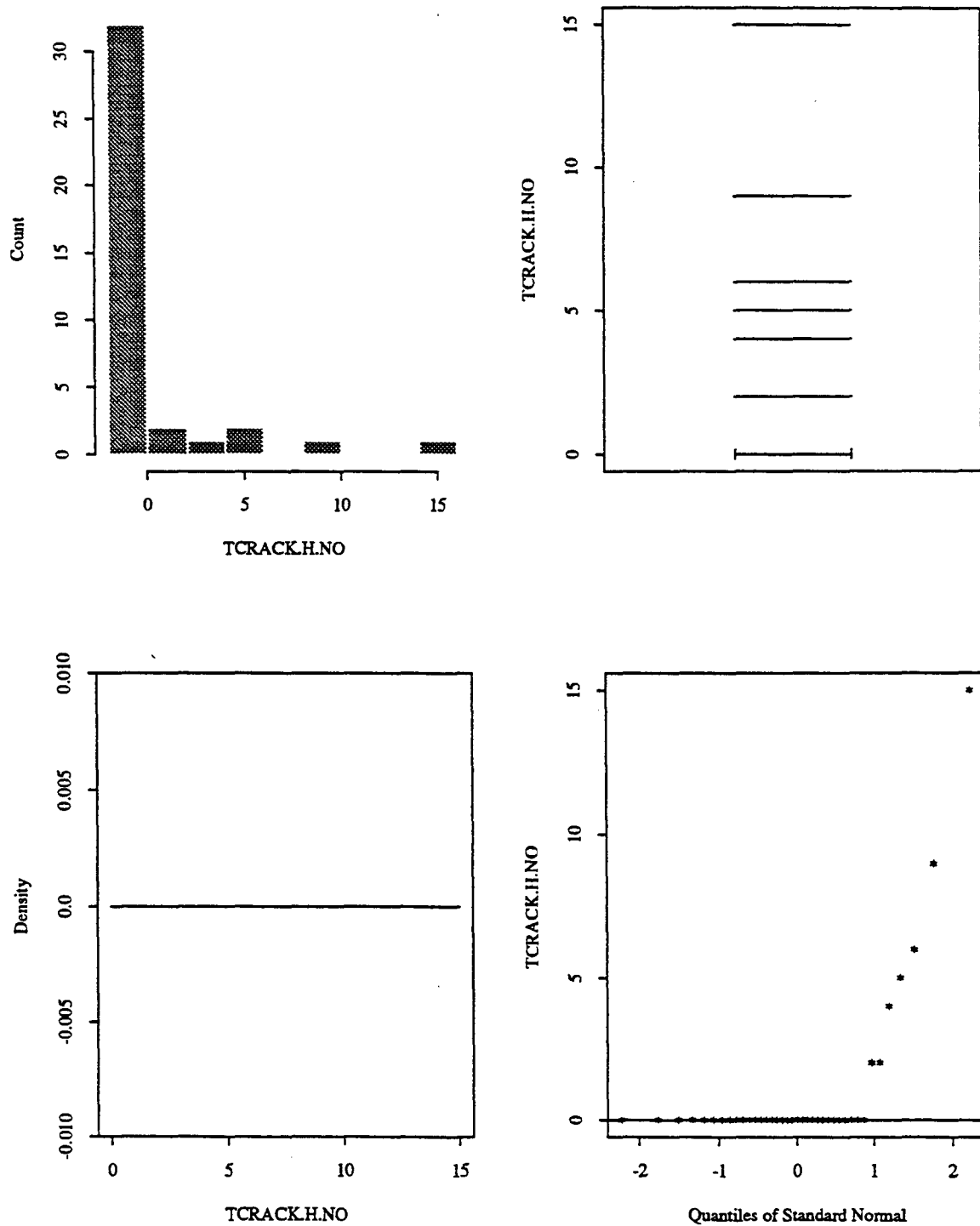


Figure 5.12 Statistical Distribution of High Severity Transverse Cracking for GPS-4 Sections, Number

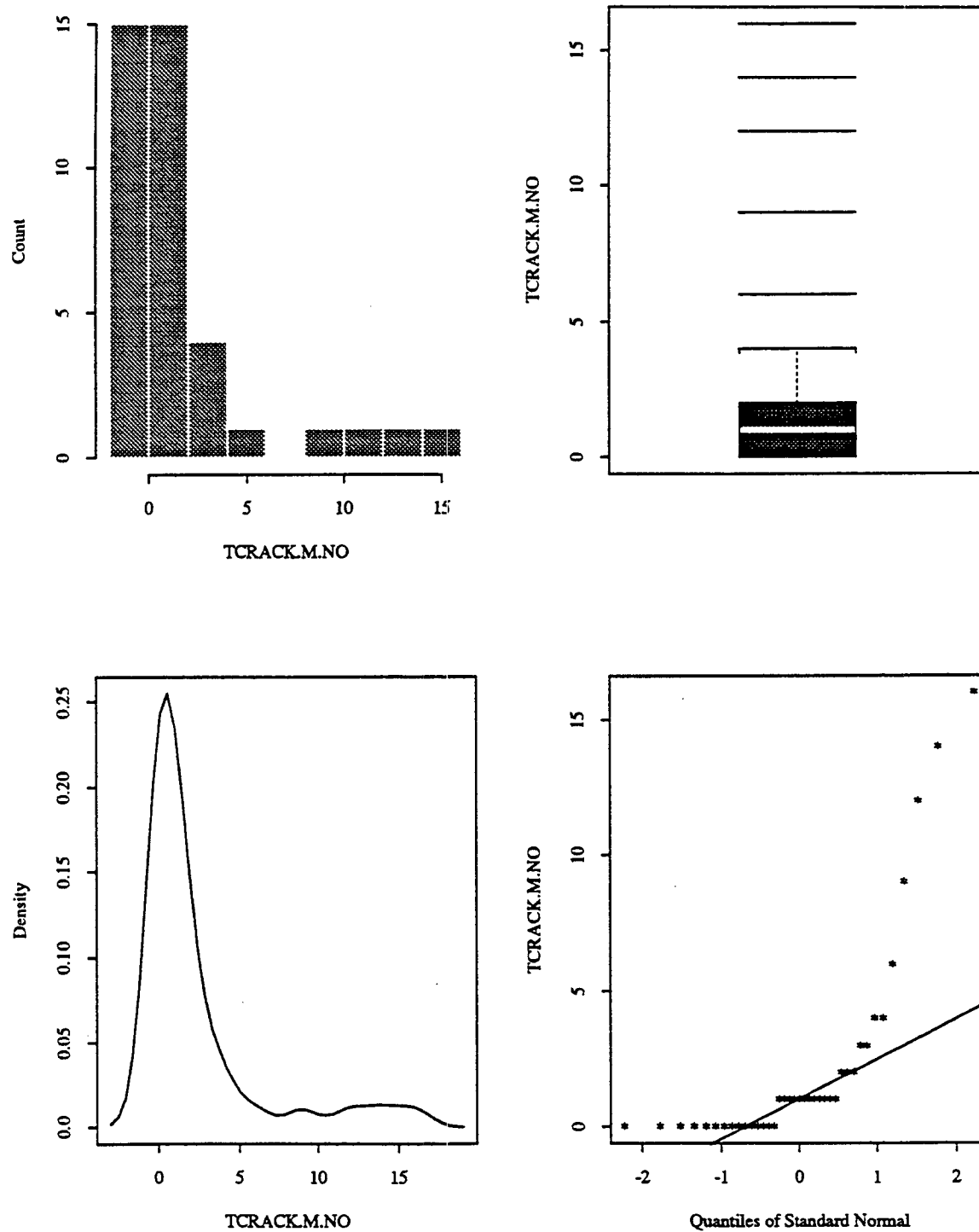


Figure 5.13 Statistical Distribution of Medium Severity Transverse Cracking for GPS-4 Sections, Number

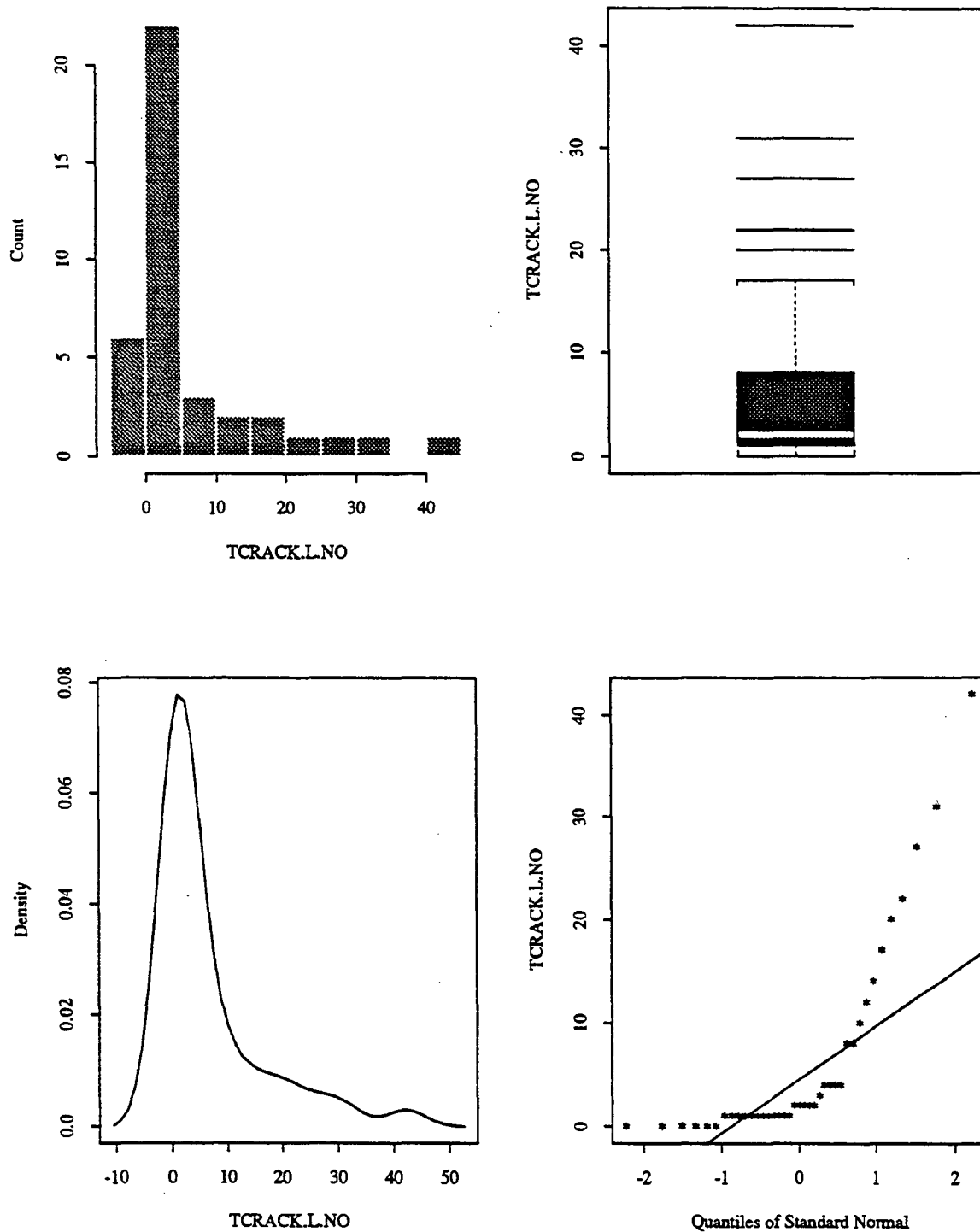


Figure 5.14 Statistical Distribution of Low Severity Transverse Cracking for GPS-4 Sections, Number

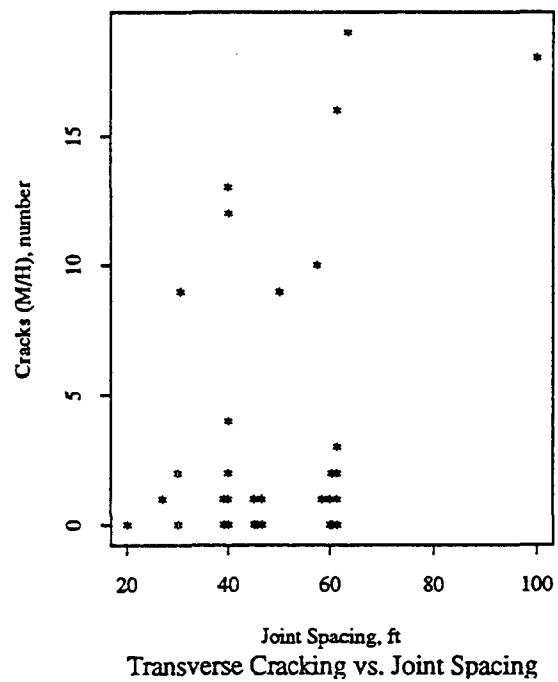
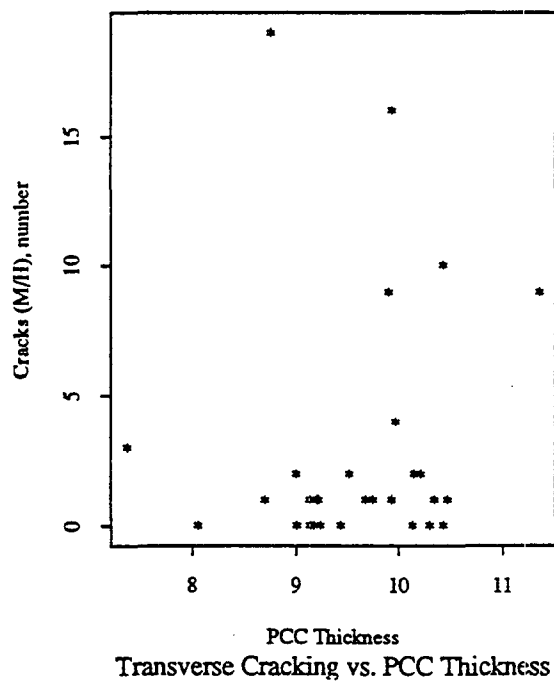
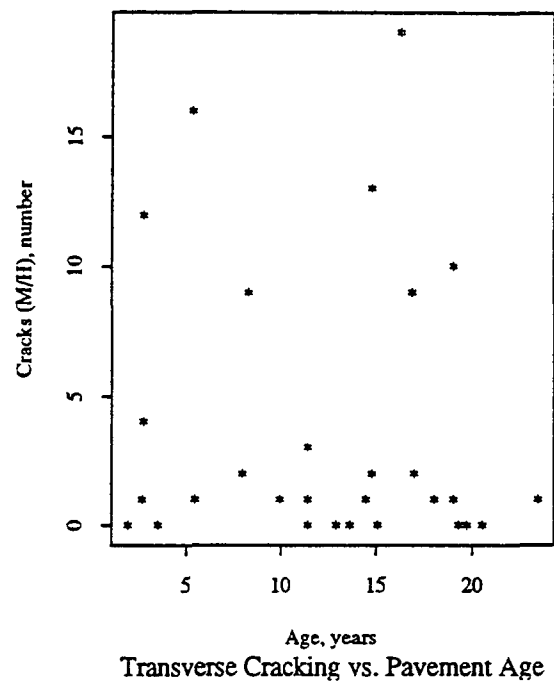
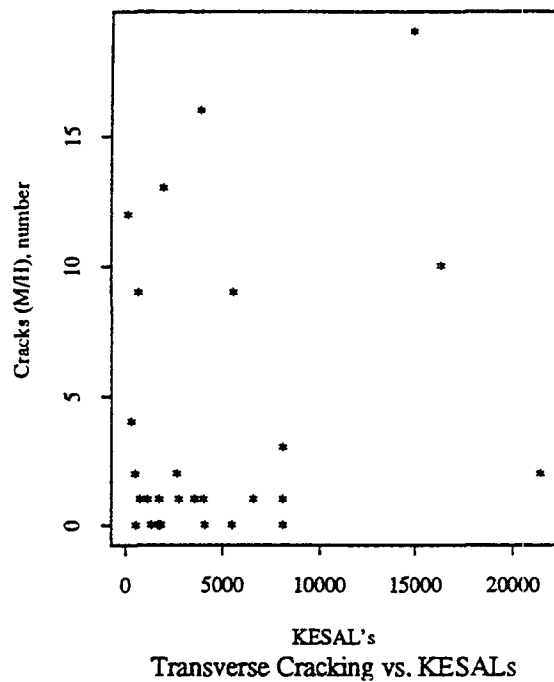


Figure 5.15 Transverse Cracking Scatter Plots for GPS-4 Sections

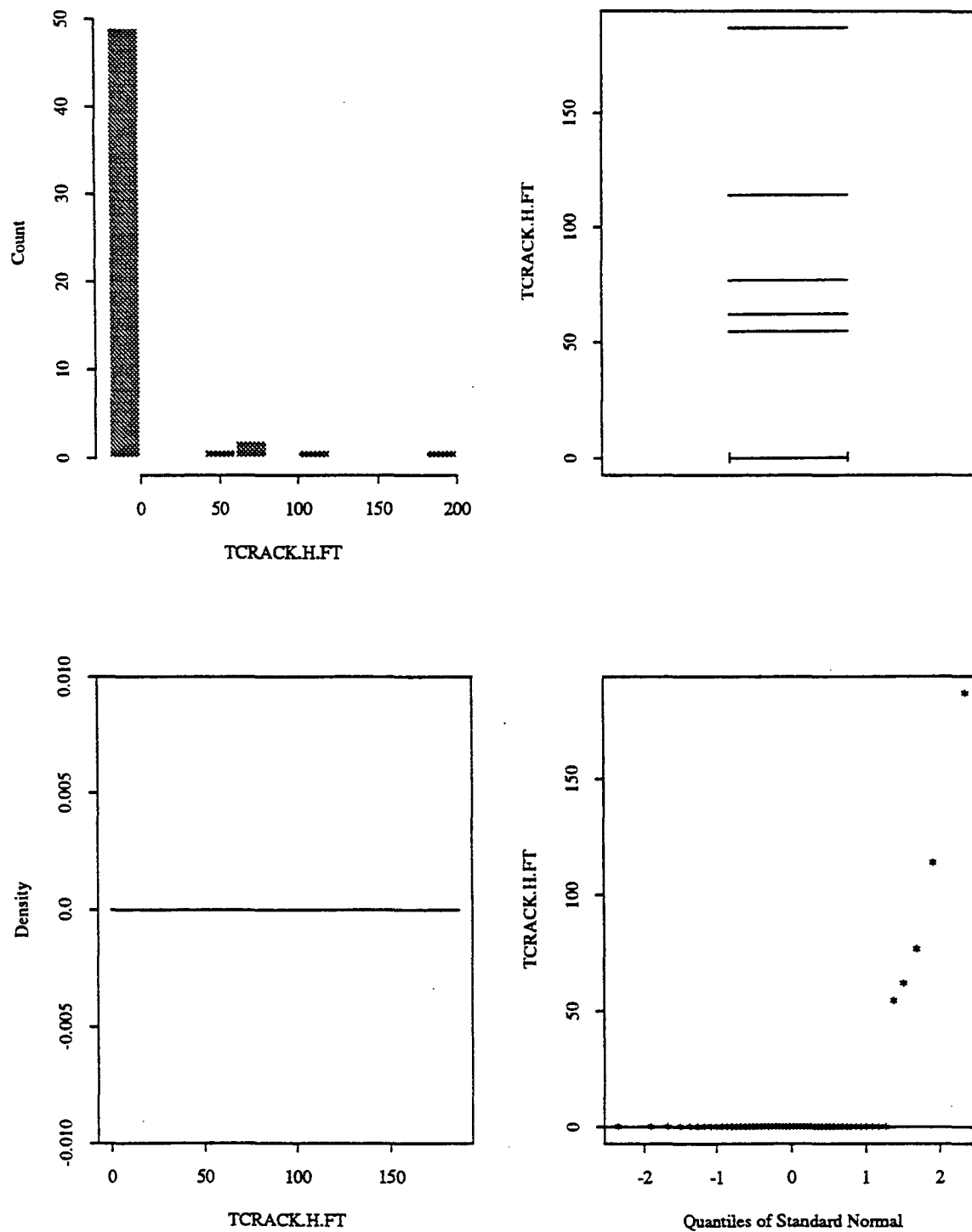


Figure 5.16 Statistical Distribution of High Severity Transverse Cracking for GPS-4 Sections, Ft.

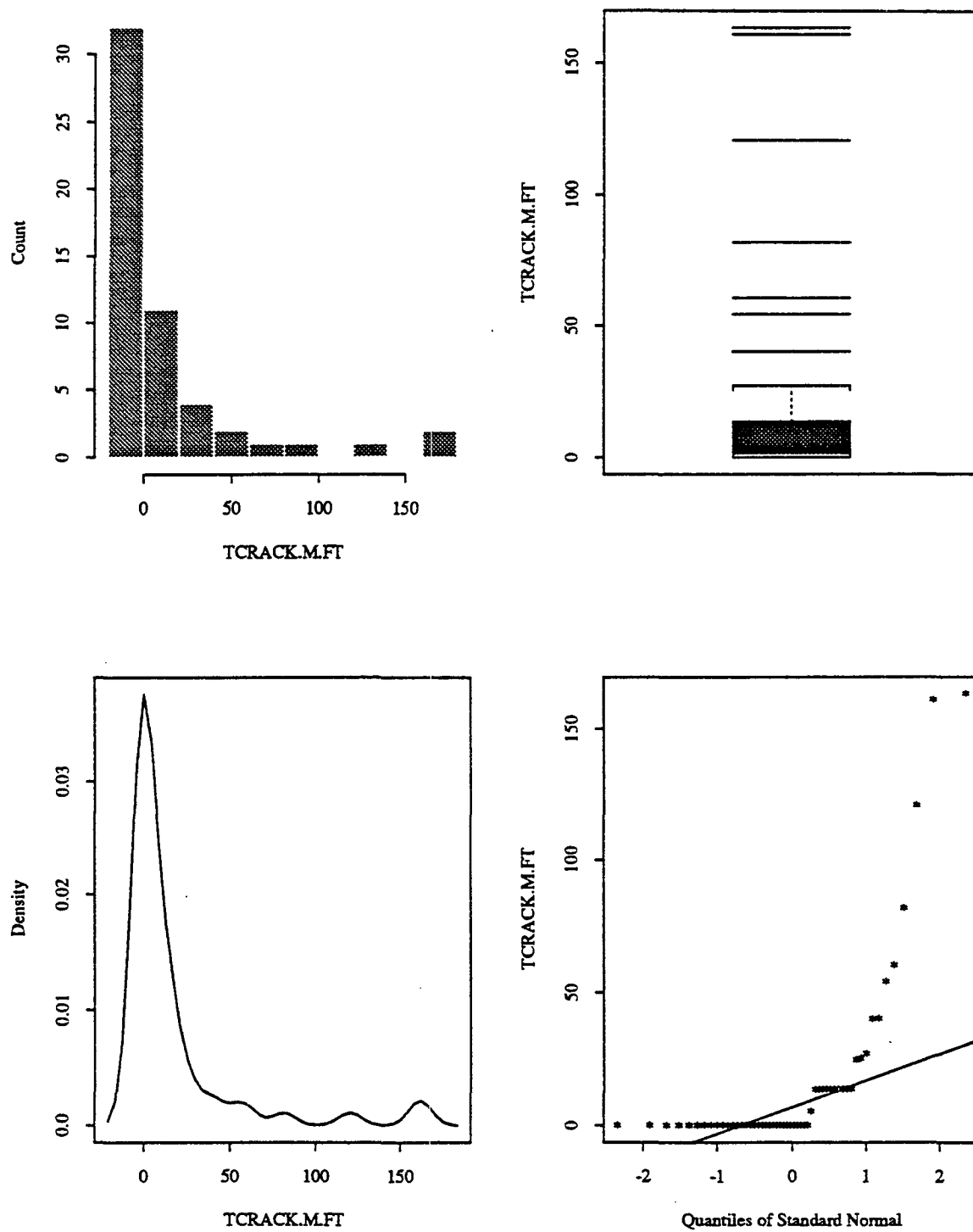


Figure 5.17 Statistical Distribution of Medium Severity Transverse Cracking for GPS-4 Sections, Ft.

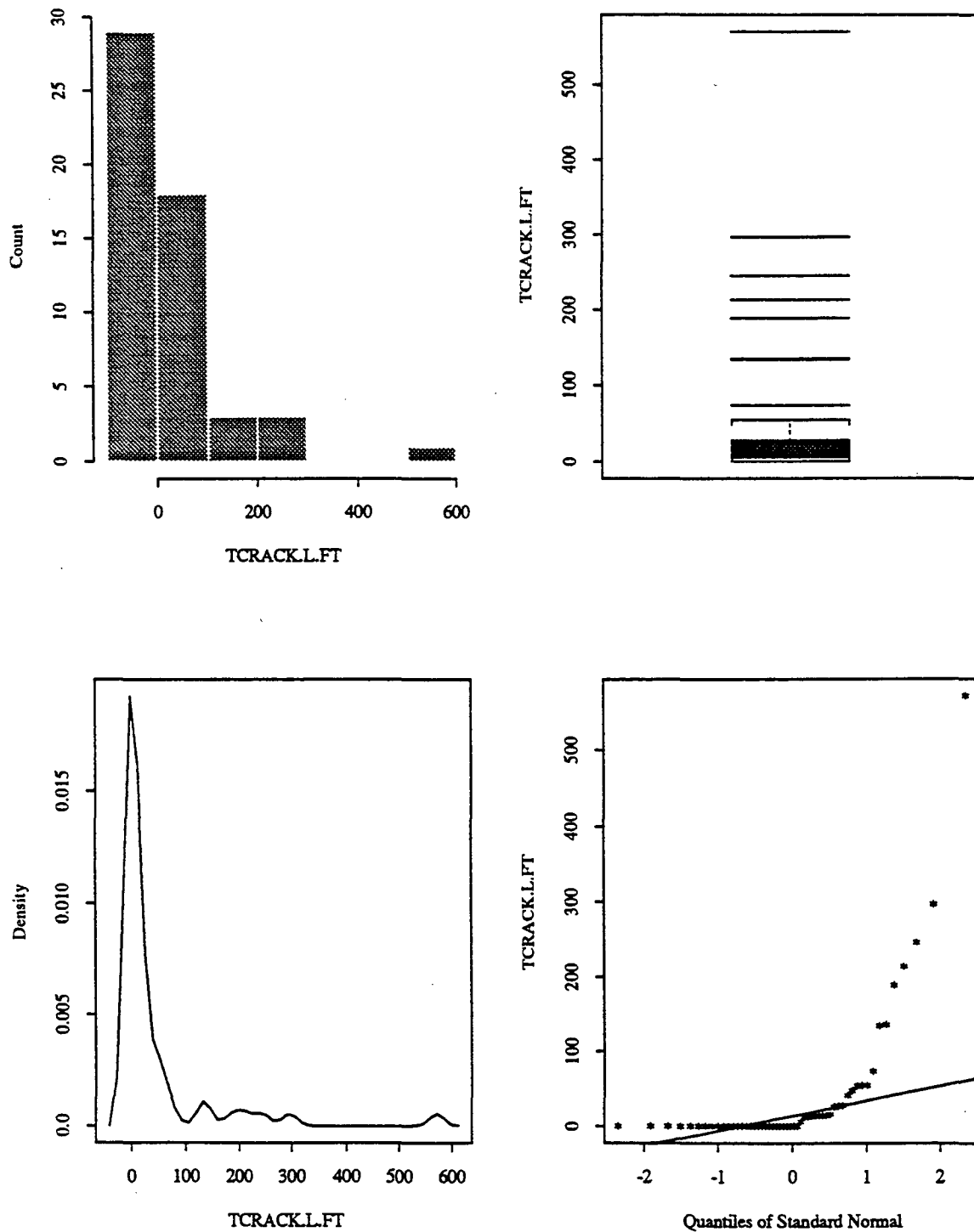


Figure 5.18 Statistical Distribution of Low Severity Transverse Cracking for GPS-4 Sections, Ft.

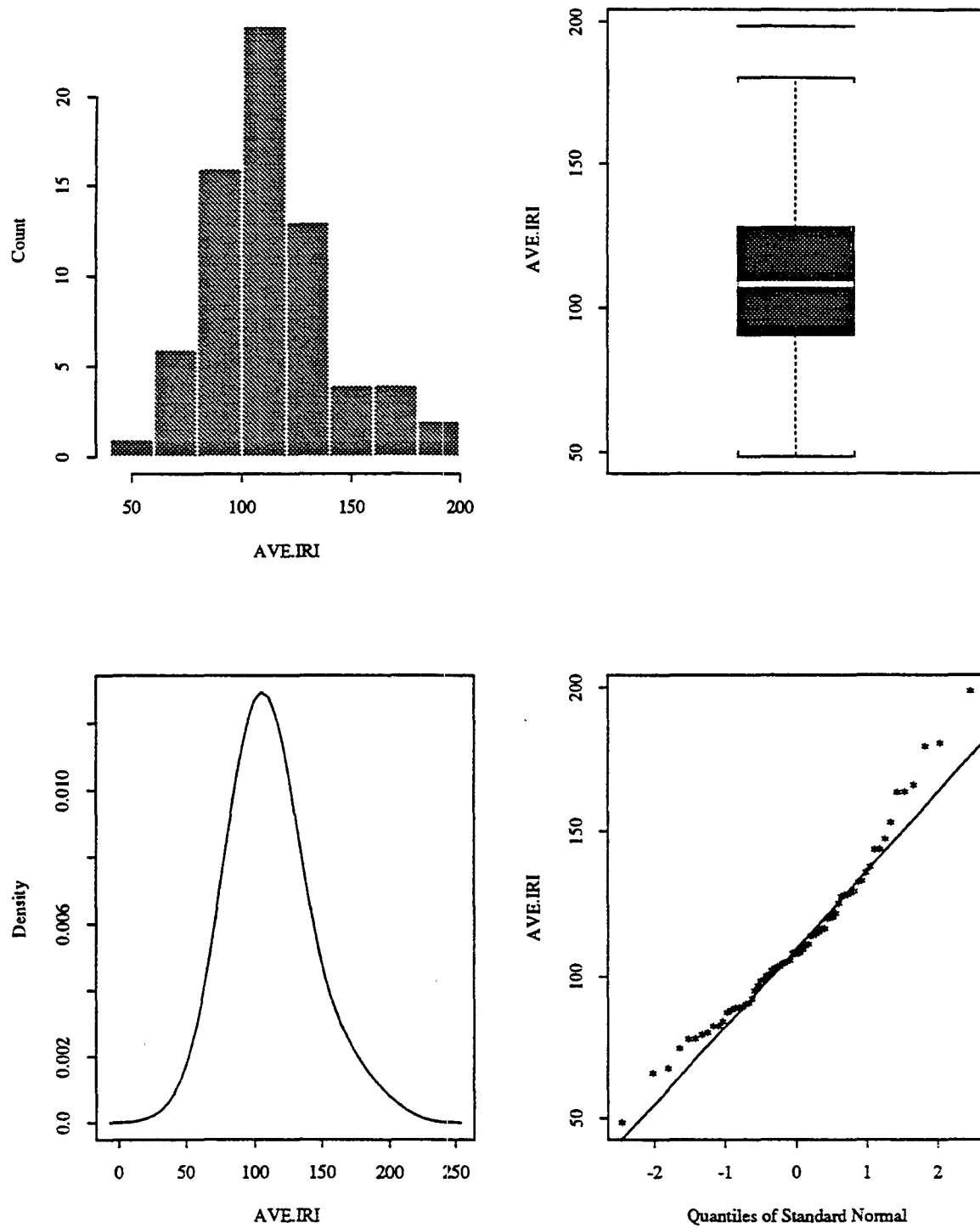


Figure 5.19 Statistical Distribution of Average IRI for GPS-4 Sections, In./Mile

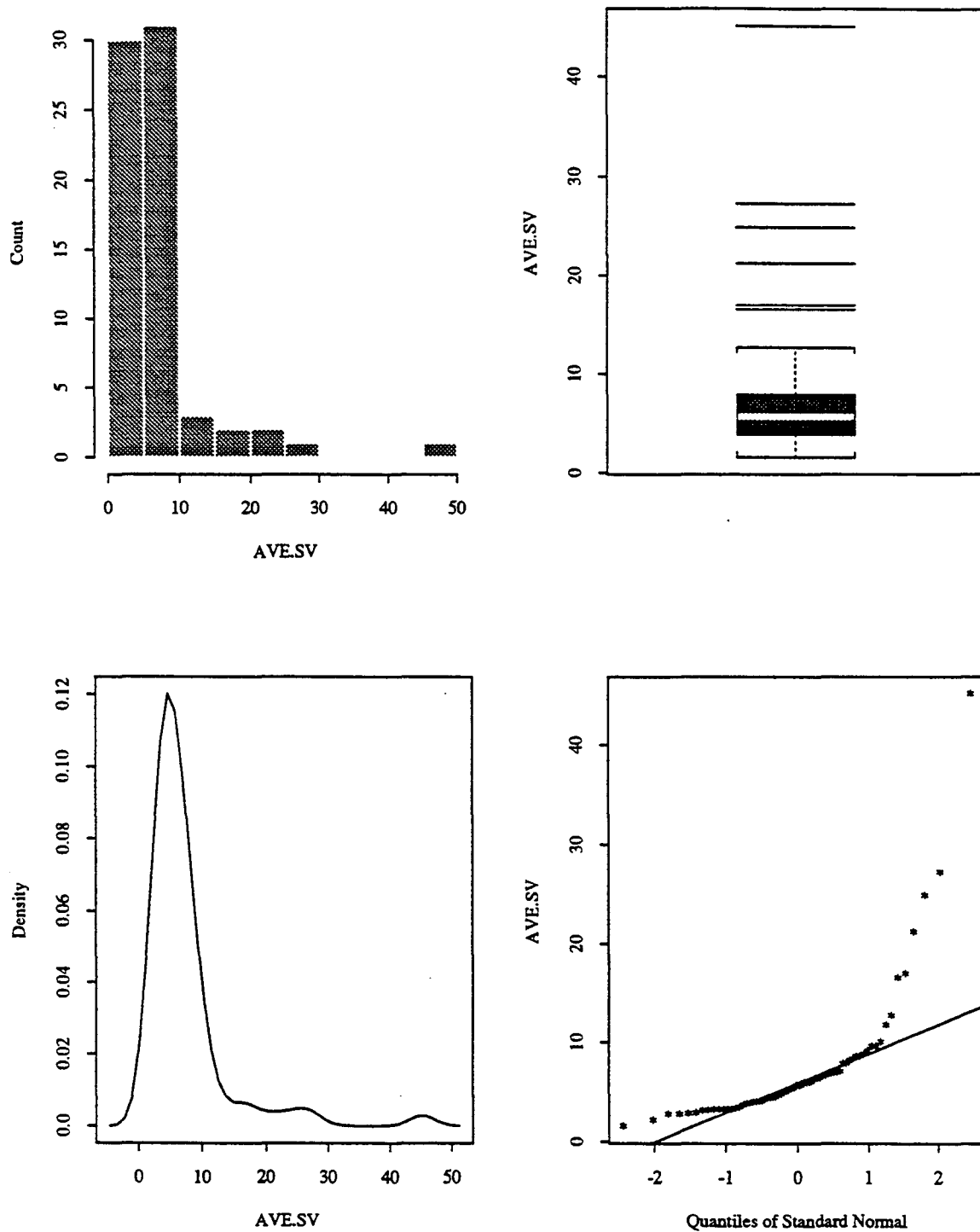


Figure 5.20 Statistical Distribution of Average Slope Variance for GPS-4 Sections

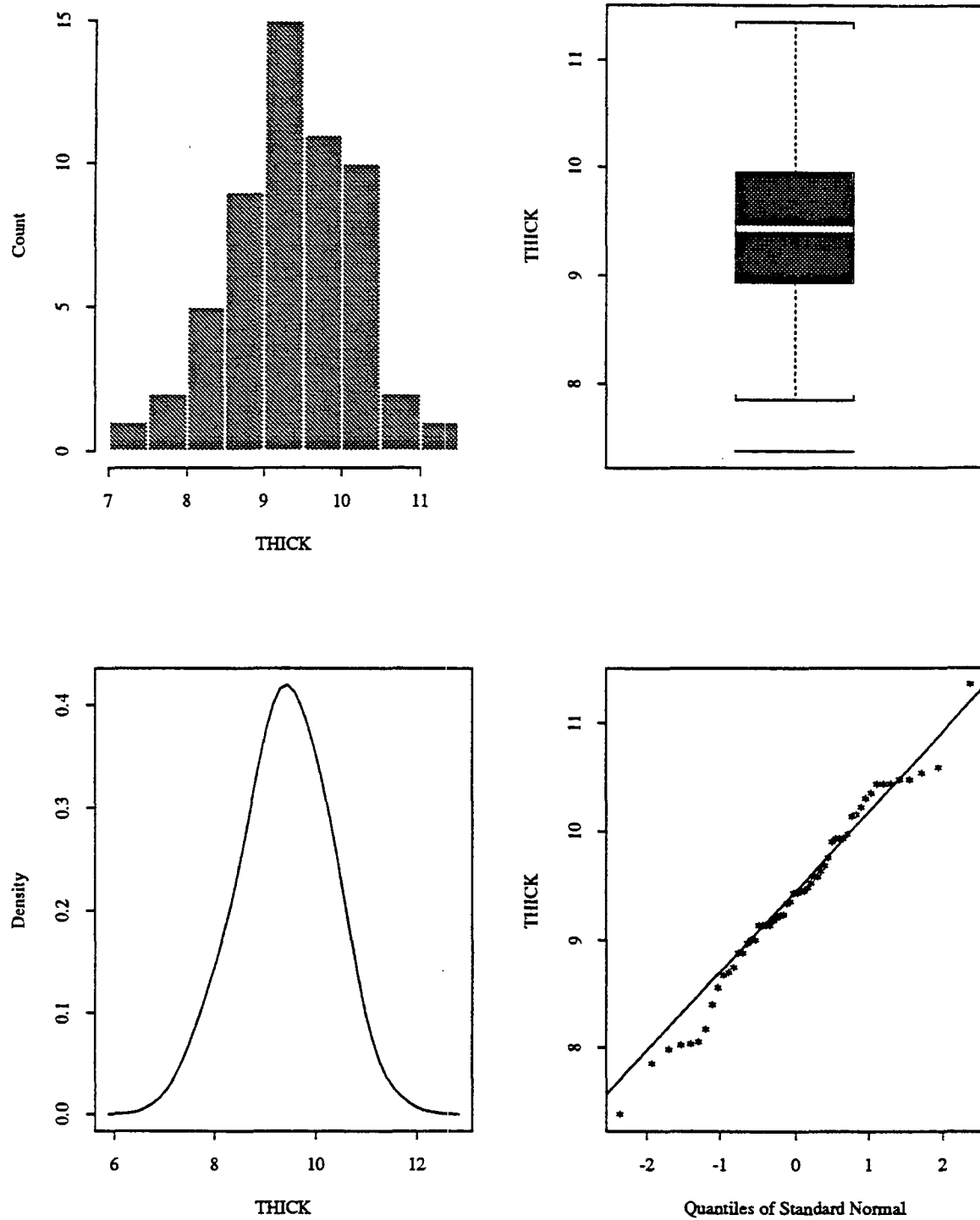


Figure 5.21 Statistical Distribution of PCC Thickness for GPS-4 Sections

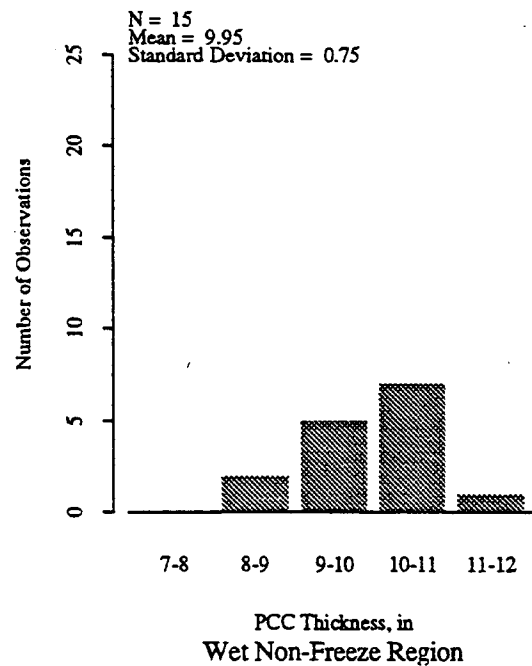
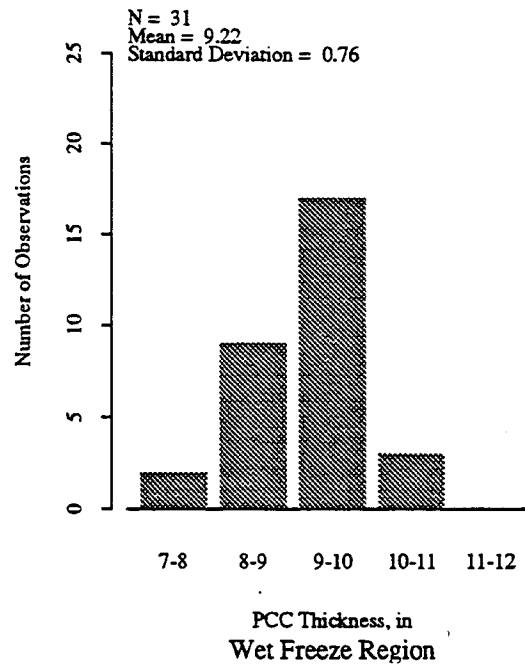
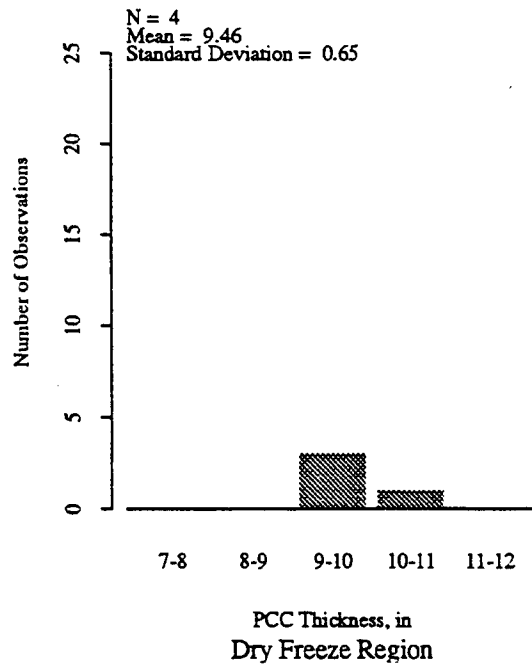


Figure 5.22 Distribution of PCC Thickness by Environmental Regions for GPS-4 Sections

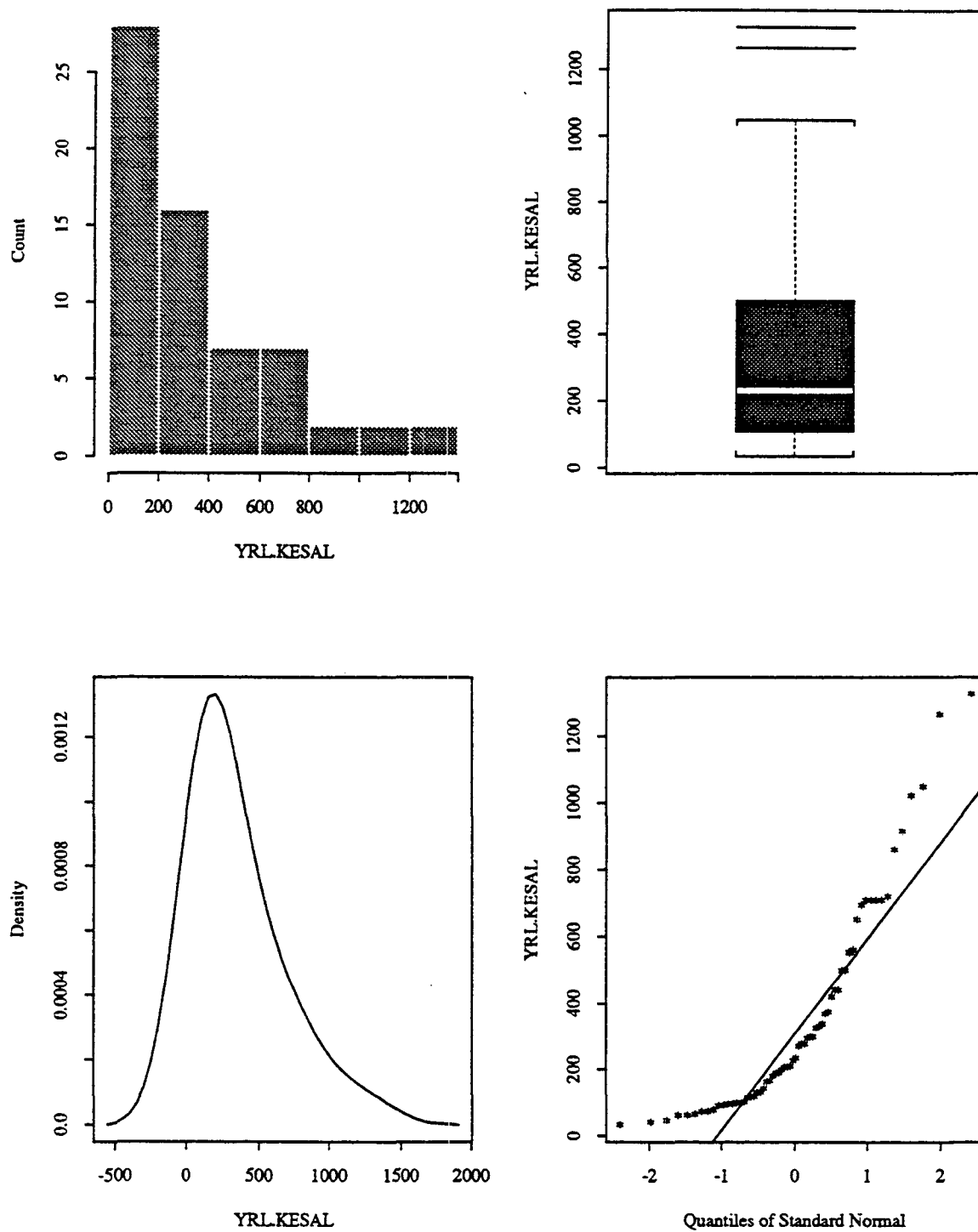


Figure 5.23 Statistical Distribution of KESALs/Year for GPS-4 Sections

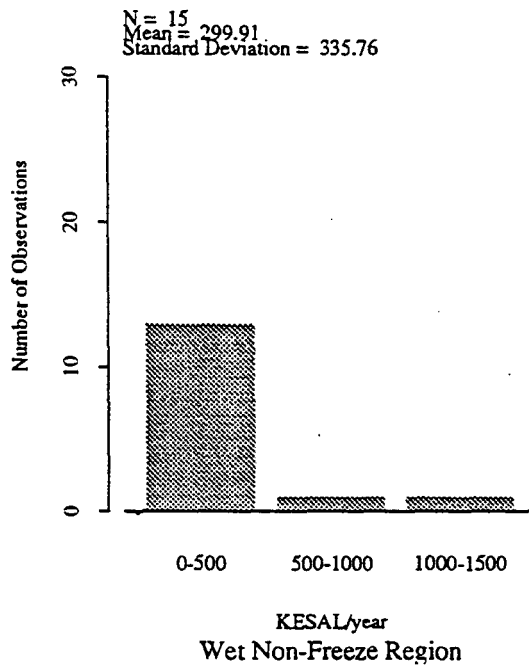
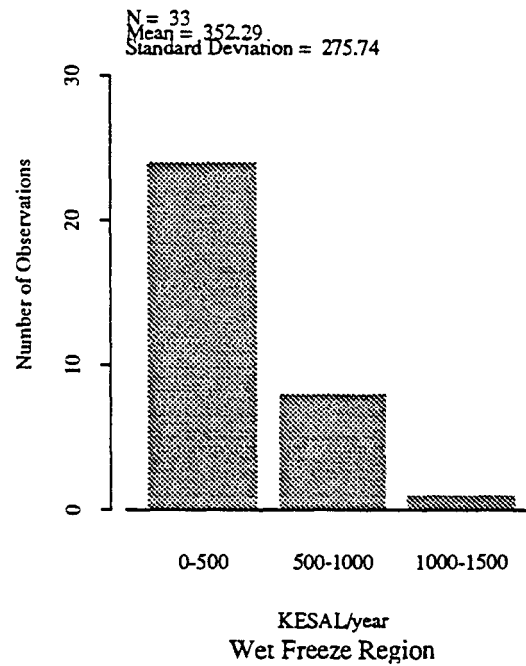
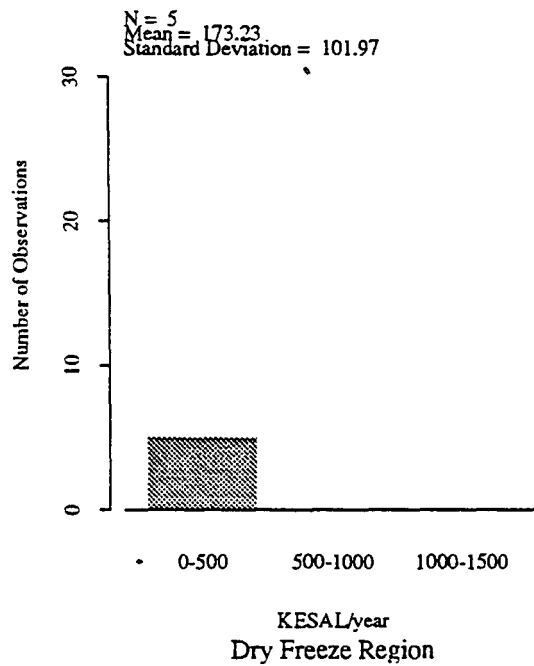


Figure 5.24 Distribution of KESALs/Year by Environmental Regions for GPS-4 Sections

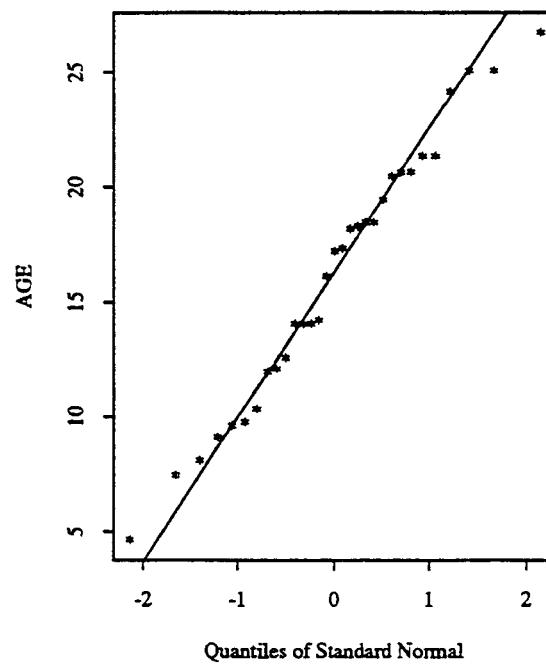
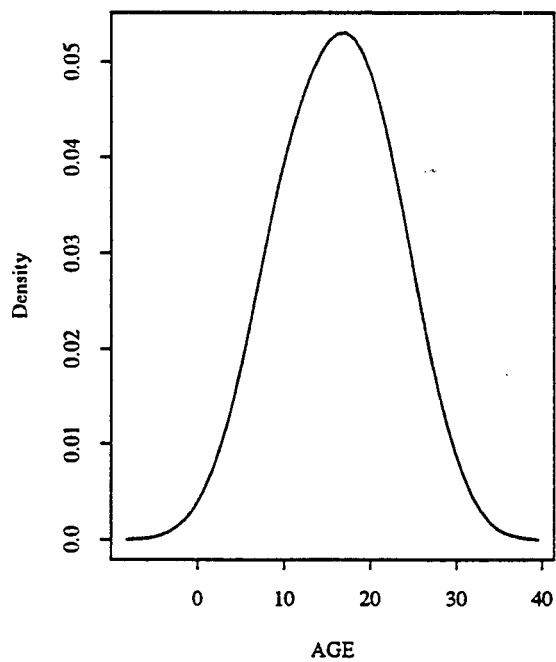
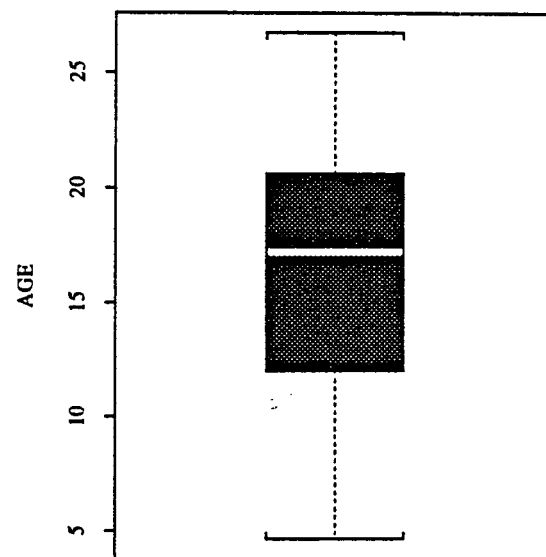
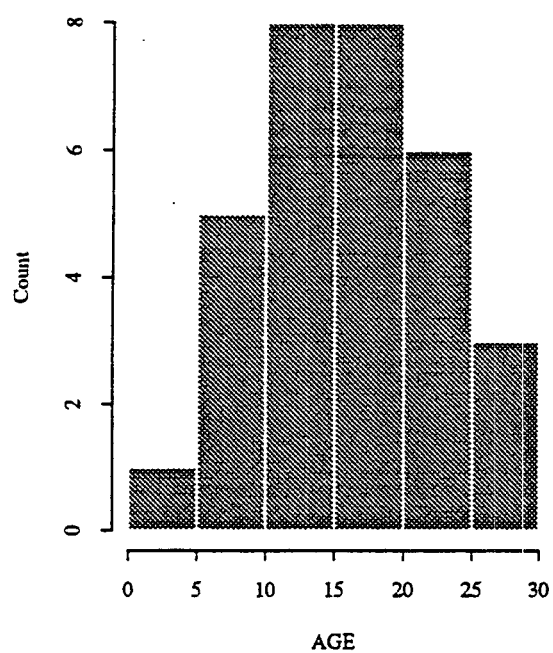


Figure 5.25 Statistical Distribution of Pavement Age for GPS-4 Sections

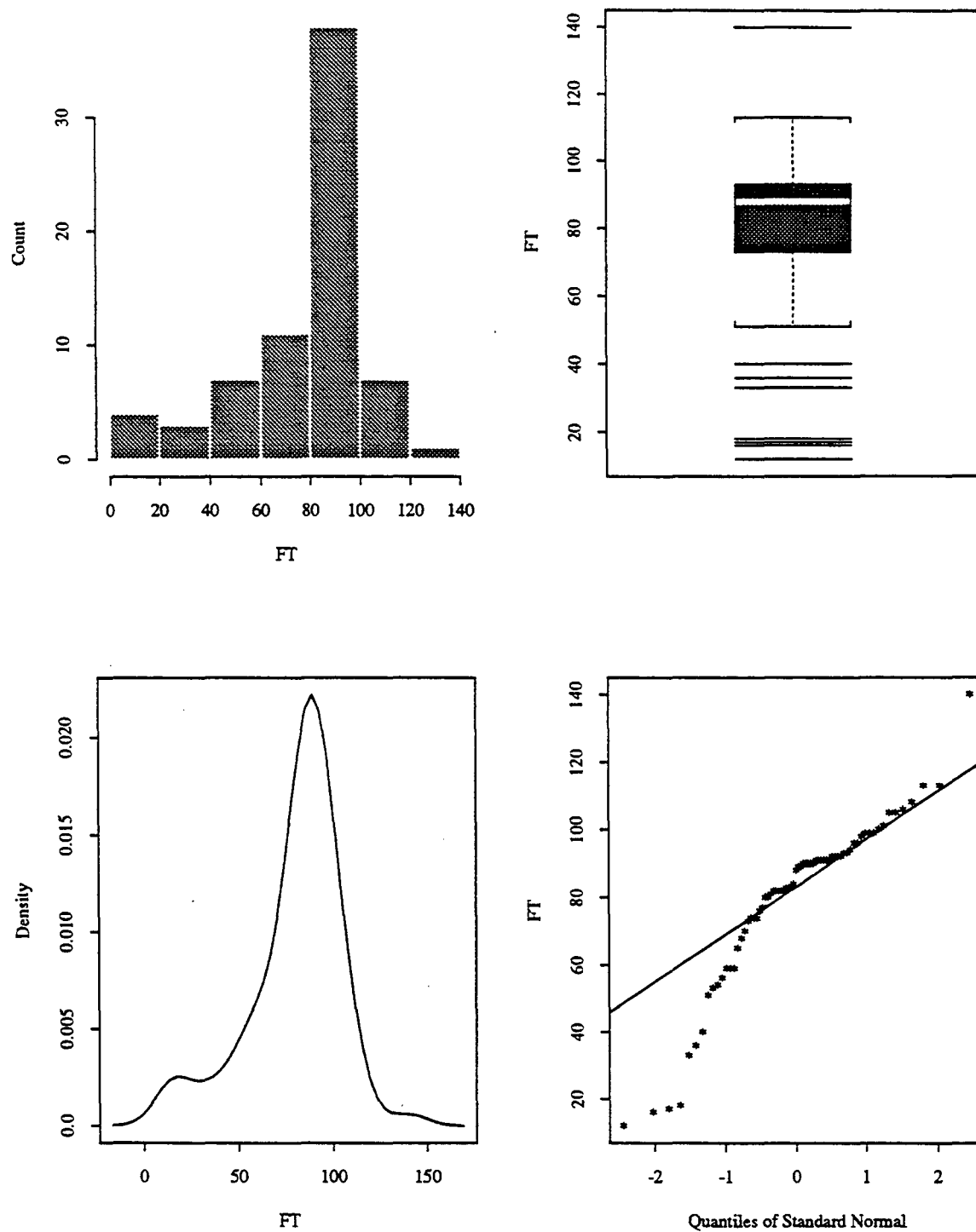


Figure 5.26 Statistical Distribution of Freeze-Thaw Cycles for GPS-4 Sections

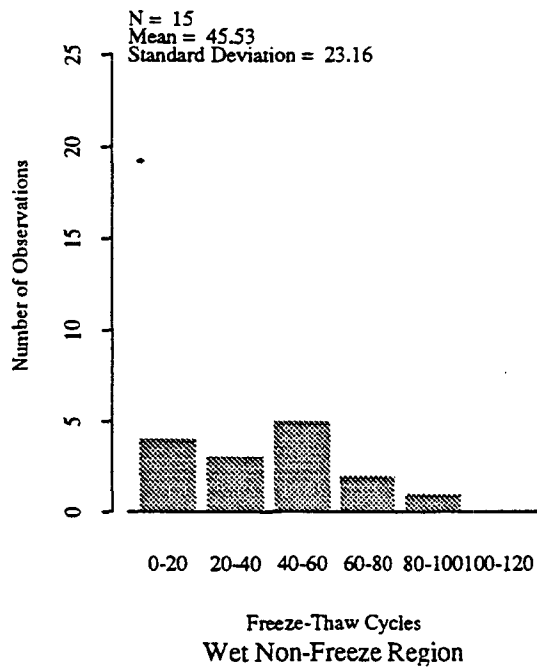
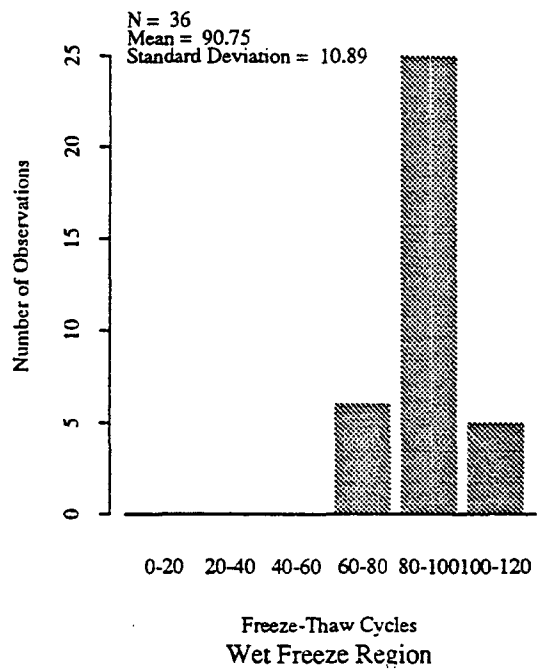
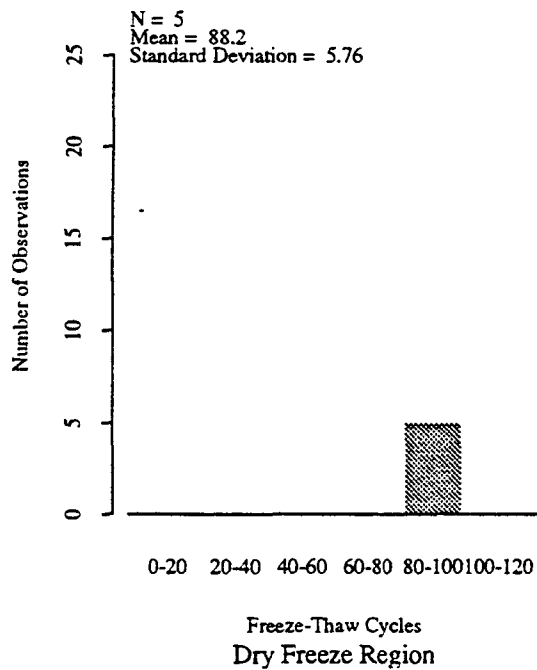


Figure 5.27 Distribution of Freeze-Thaw Cycles by Environmental Regions for GPS-4 Sections

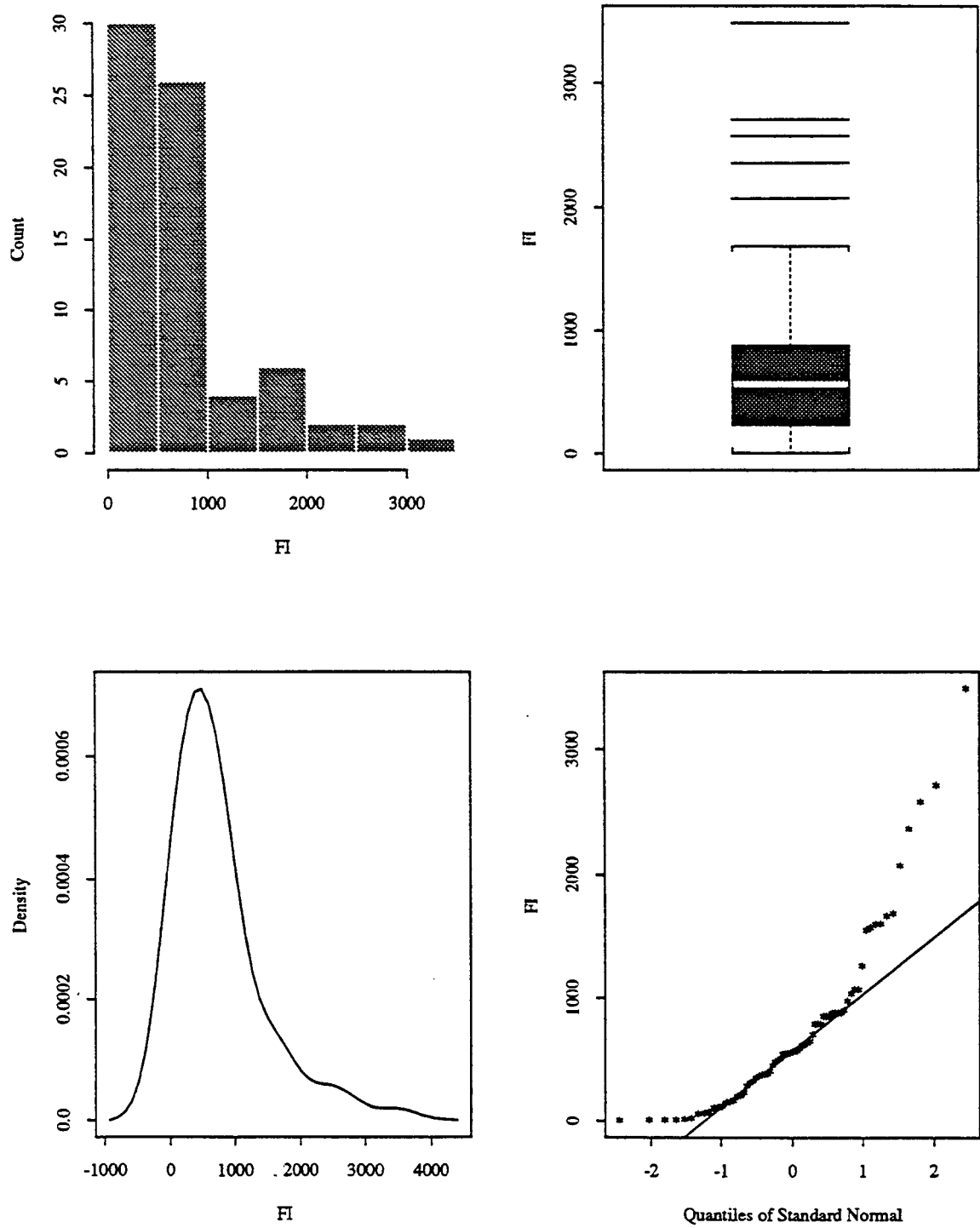


Figure 5.28 Statistical Distribution of Freezing Index for GPS-4 Sections

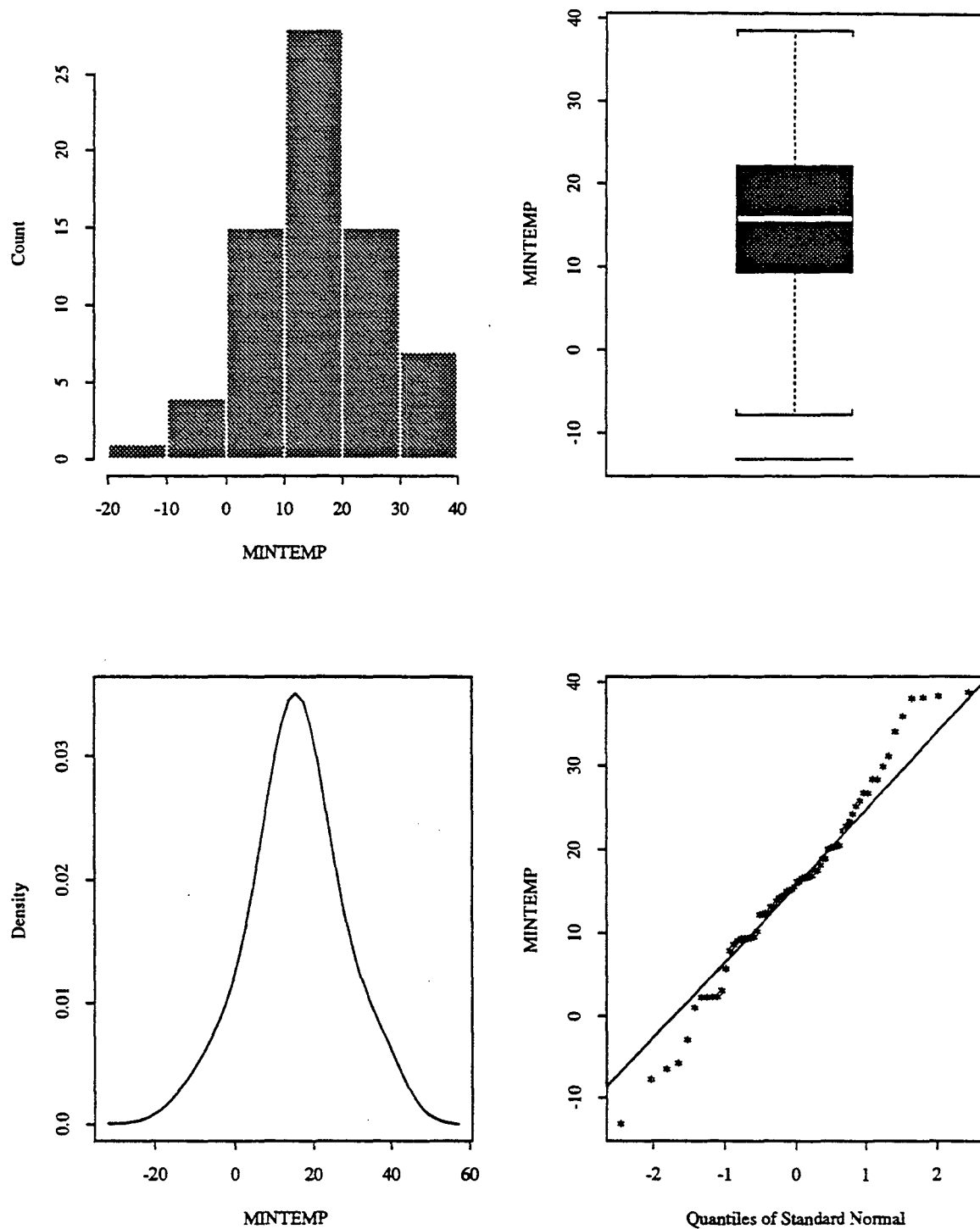


Figure 5.29 Statistical Distribution of Average Monthly Minimum Temperature for GPS-4 Sections, °F

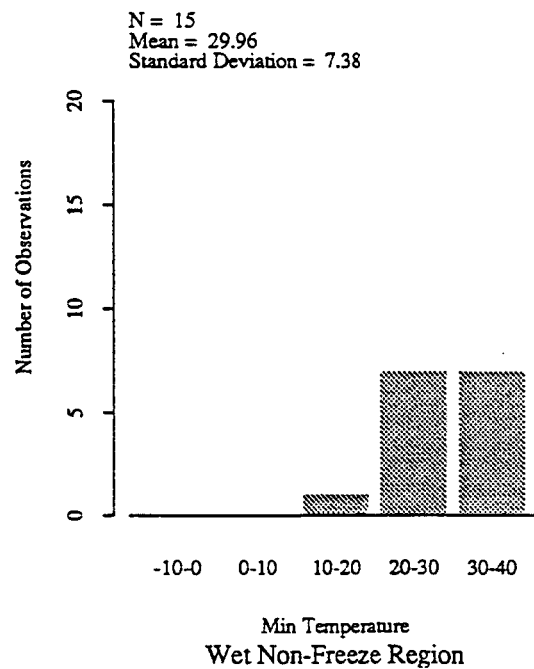
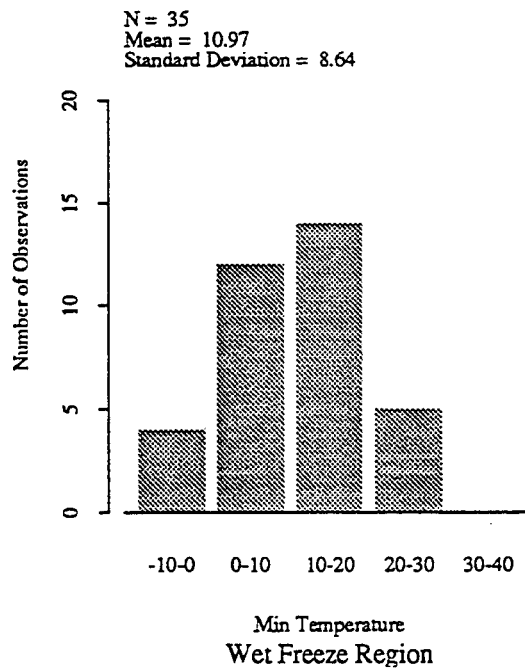
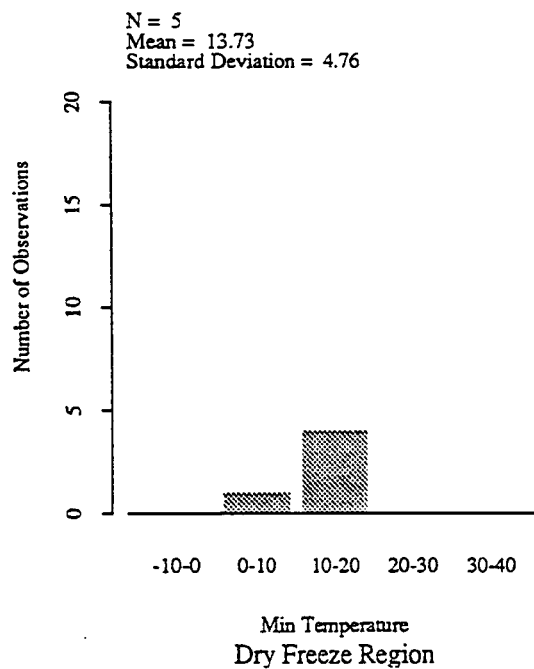


Figure 5.30 Distribution of Minimum Temperature by Environmental Regions for GPS-4 Sections, °F

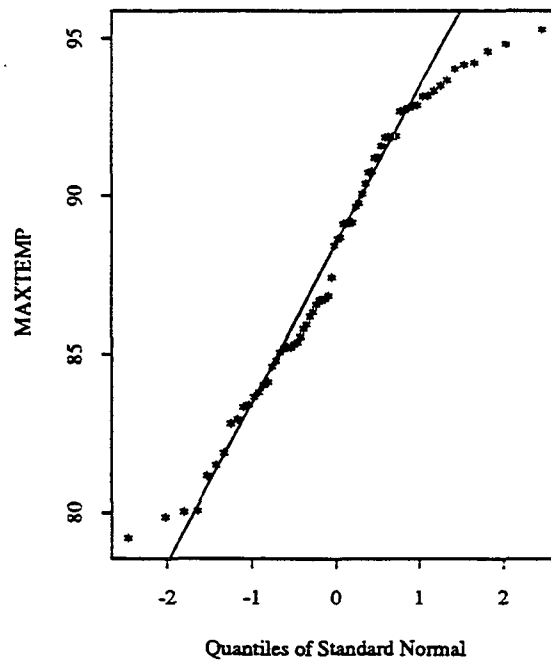
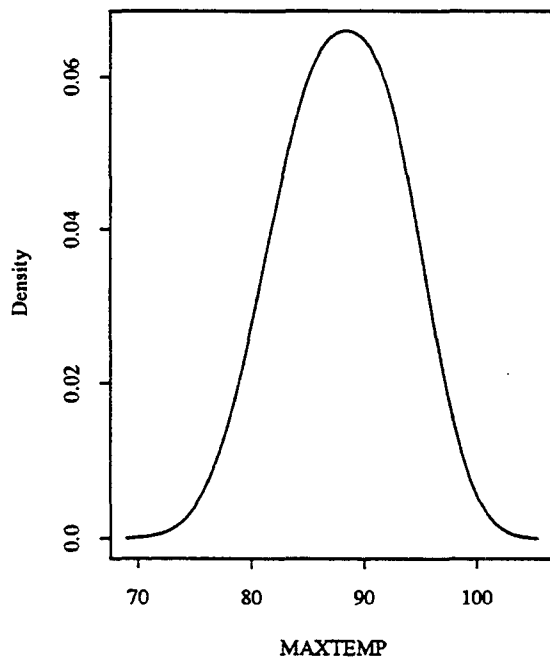
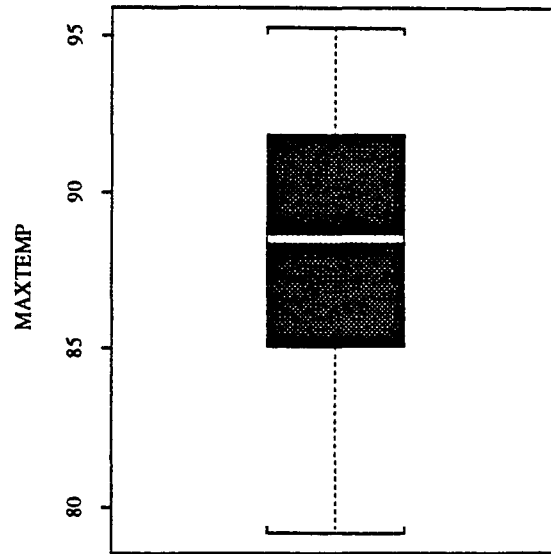
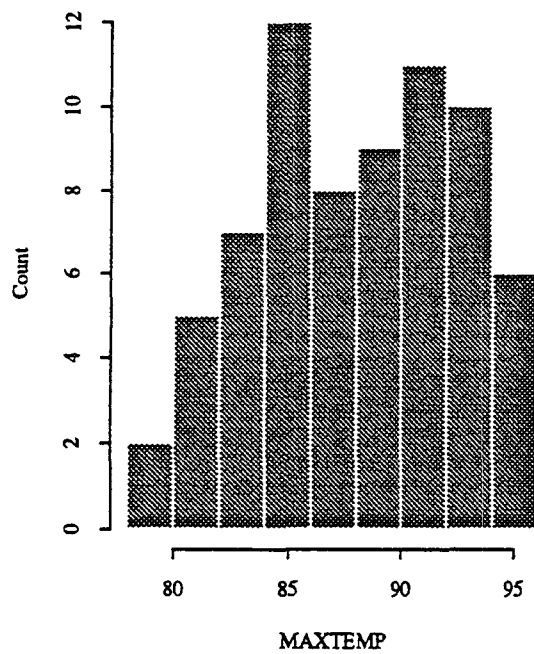


Figure 5.31 Statistical Distribution of Average Monthly Maximum Temperature for GPS-4 Sections, °F

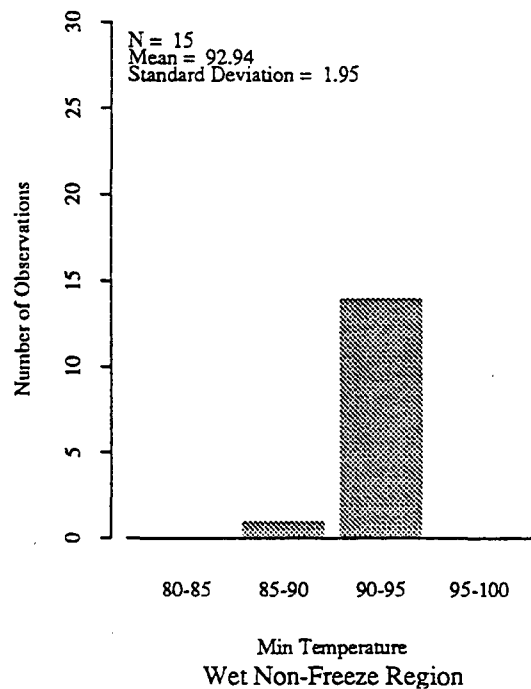
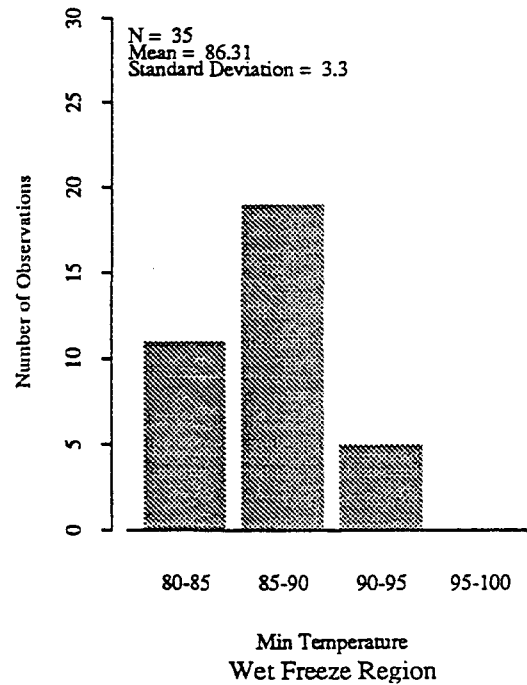
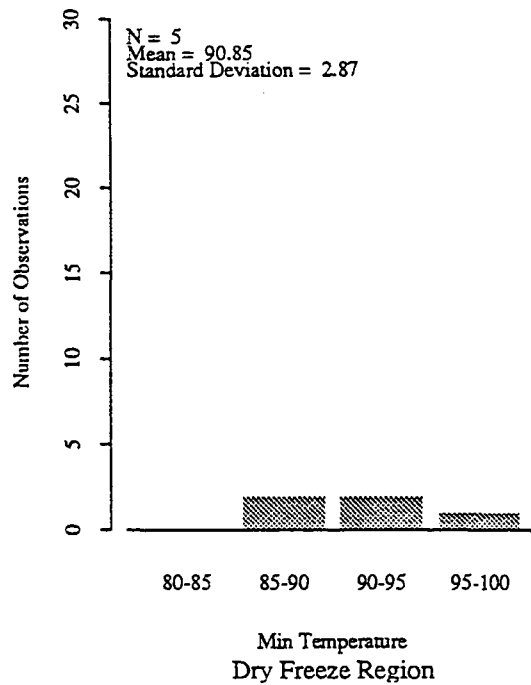


Figure 5.32 Distribution of Maximum Temperature by Environmental Regions for GPS-4 Sections, °F

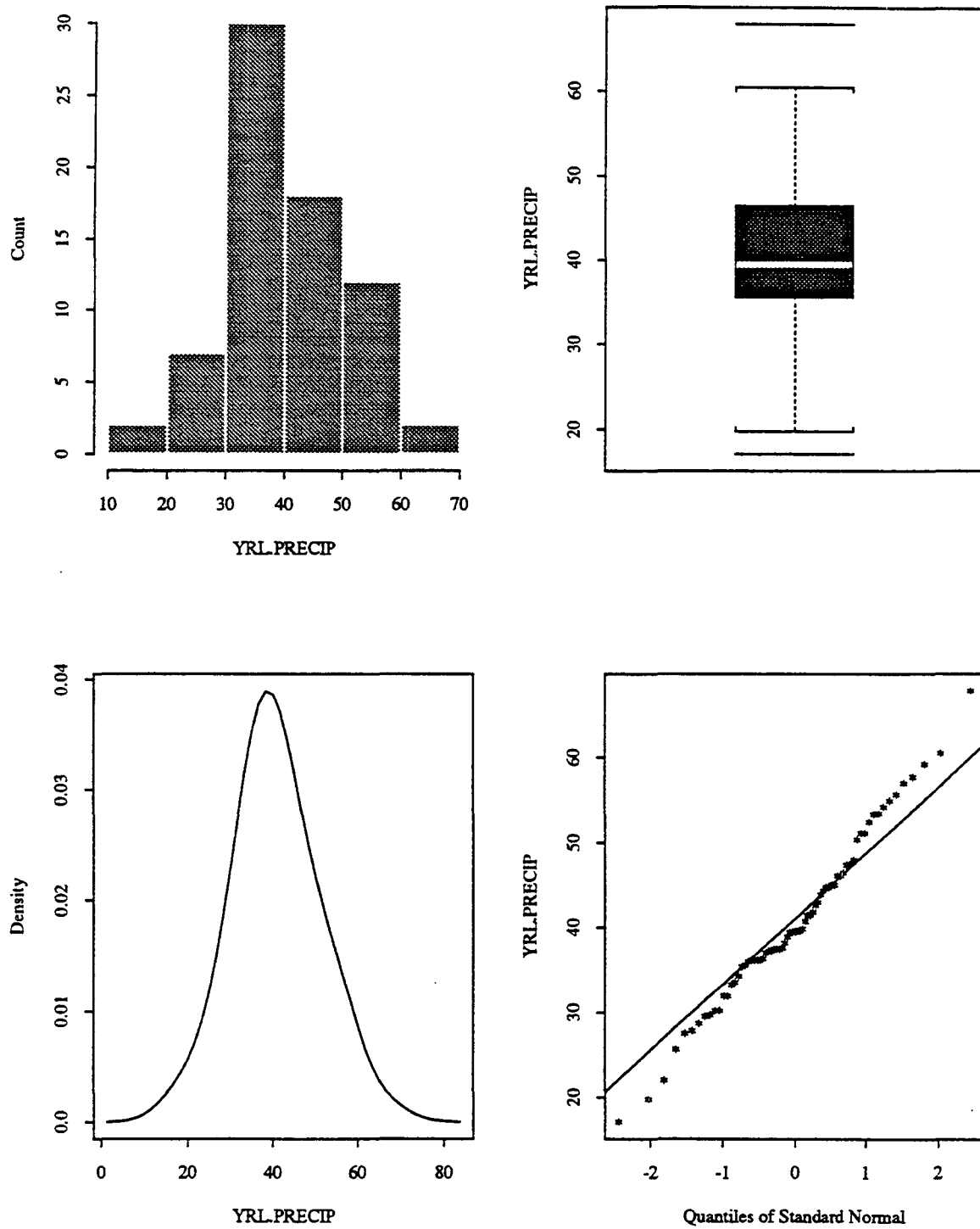


Figure 5.33 Statistical Distribution of Average Yearly Precipitation for GPS-4 Section, In.

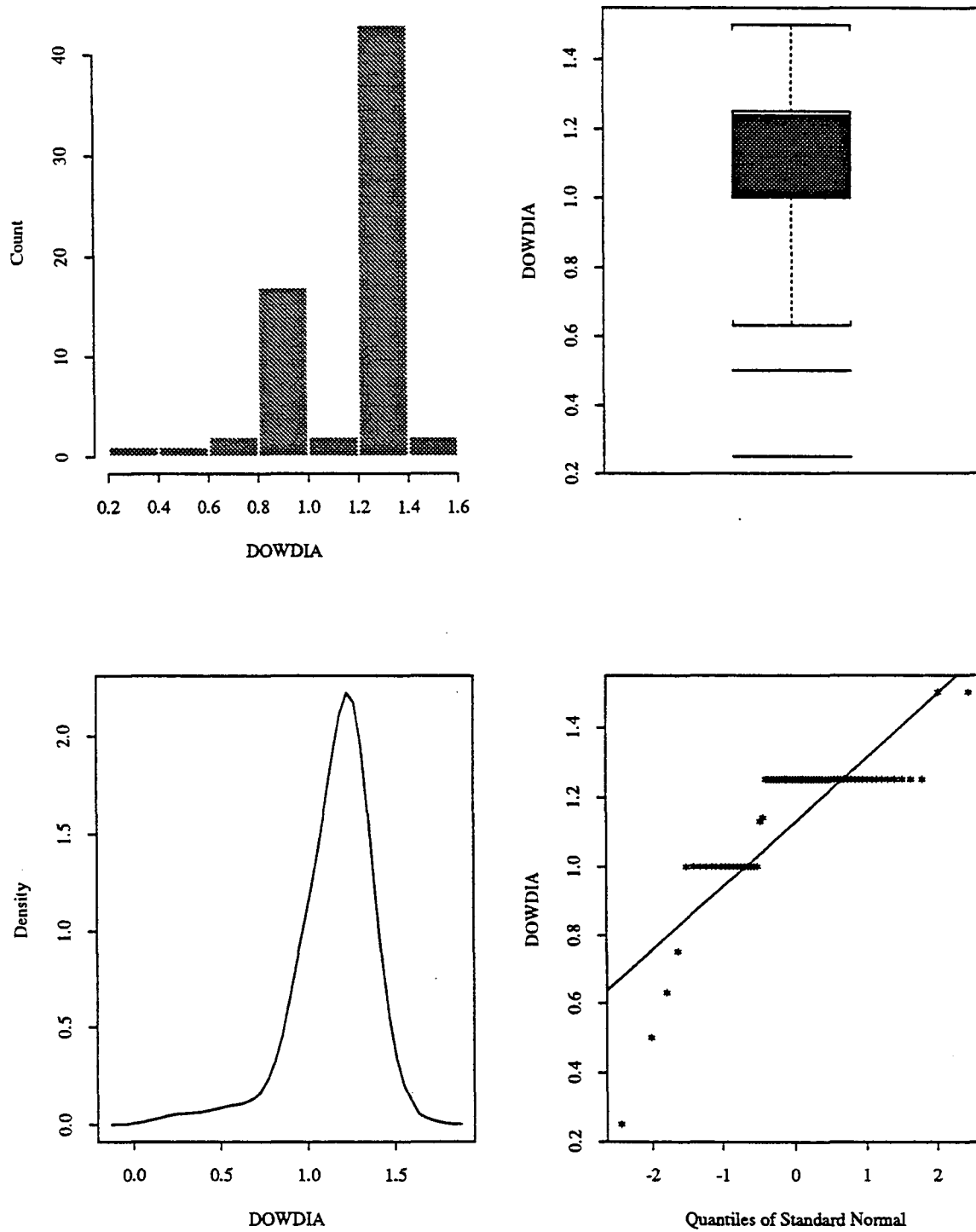


Figure 5.34 Statistical Distribution of Dowel Diameter for GPS-4 Sections

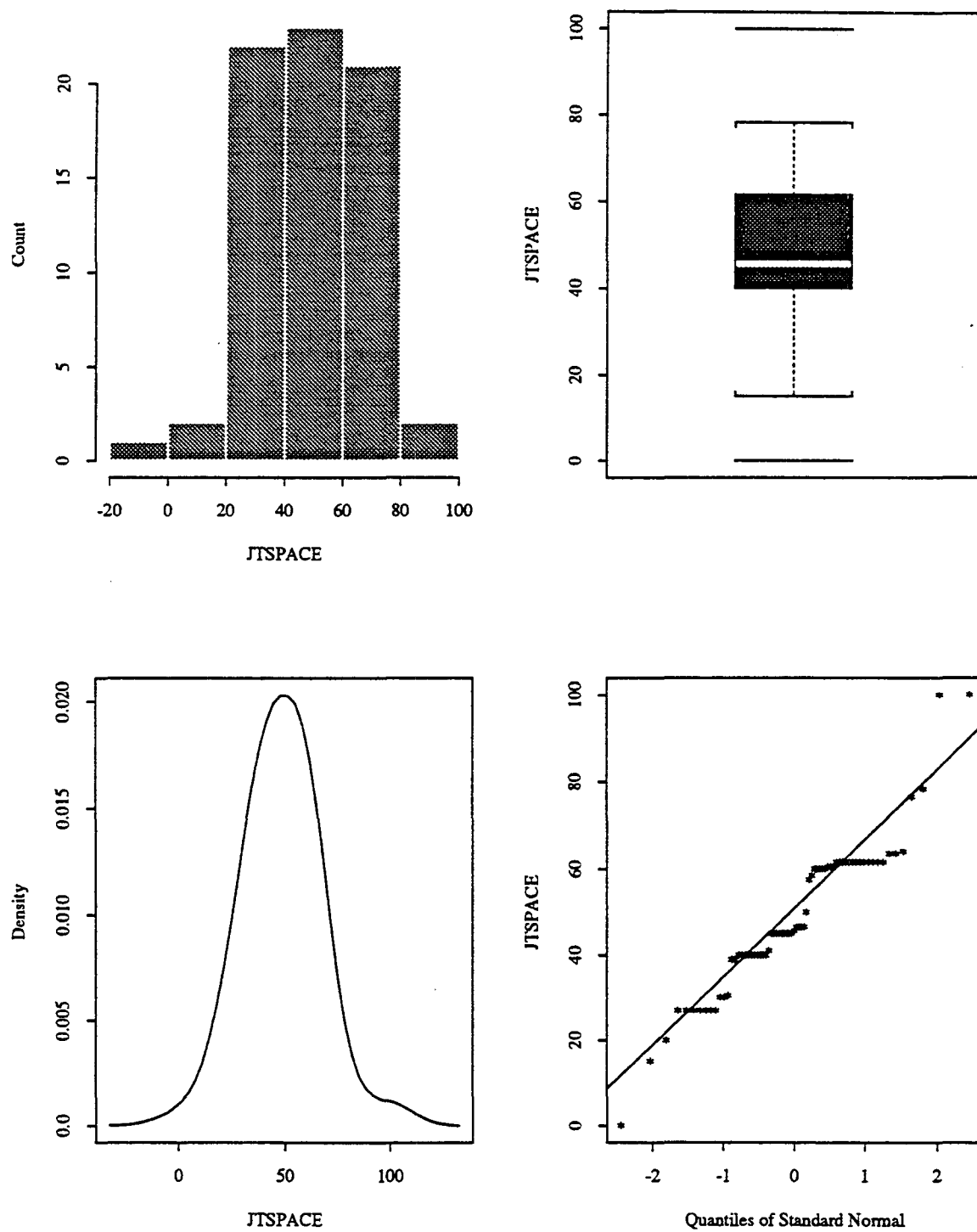


Figure 5.35 Statistical Distribution of Joint Spacing for GPS-4 Sections

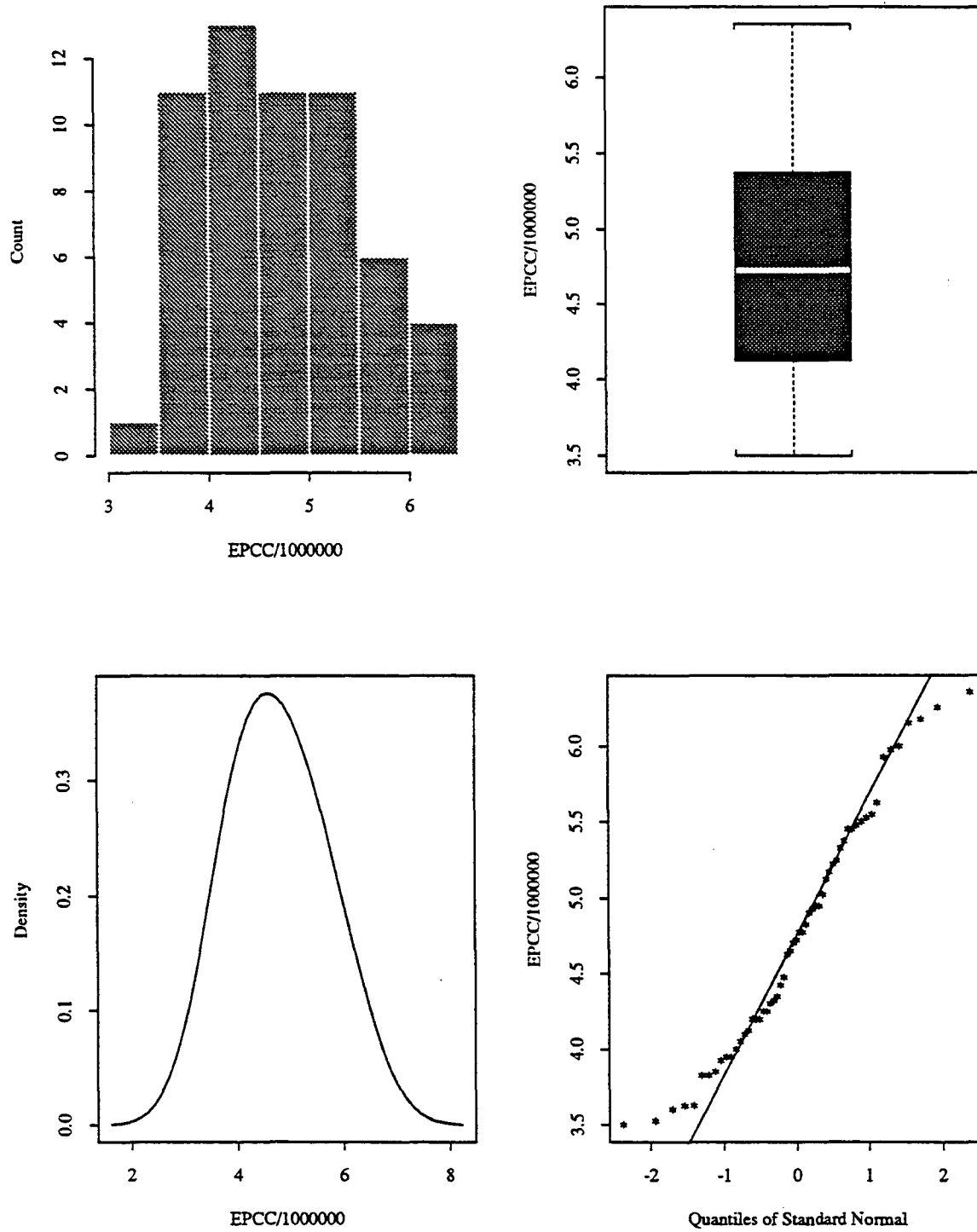


Figure 5.36 Statistical Distribution of PCC Elastic Modulus for GPS-4 Sections

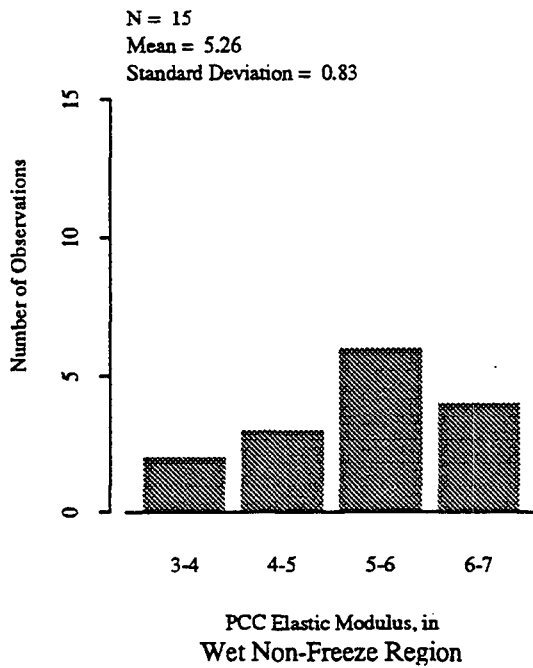
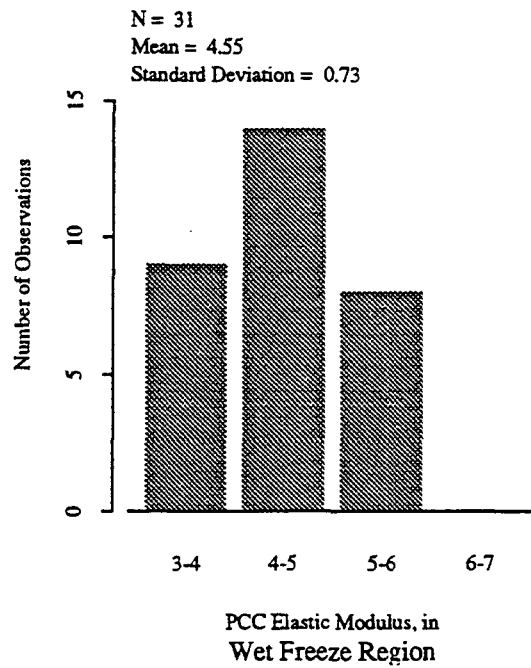
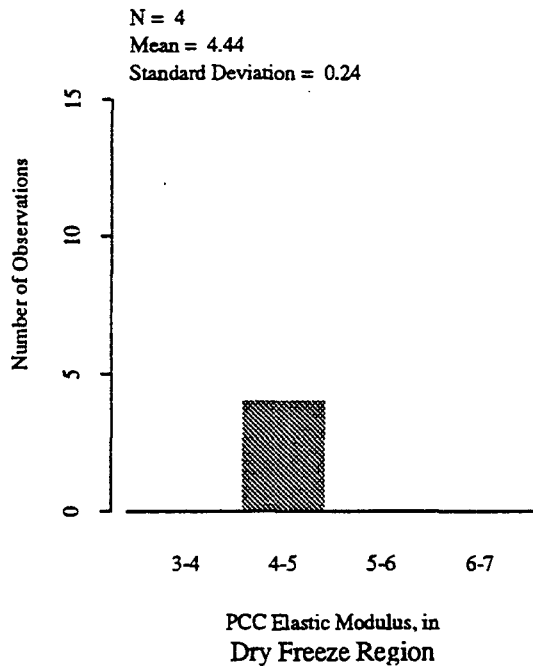


Figure 5.37 Distribution of PCC Elastic Modulus by Environmental Regions for GPS-4 Sections

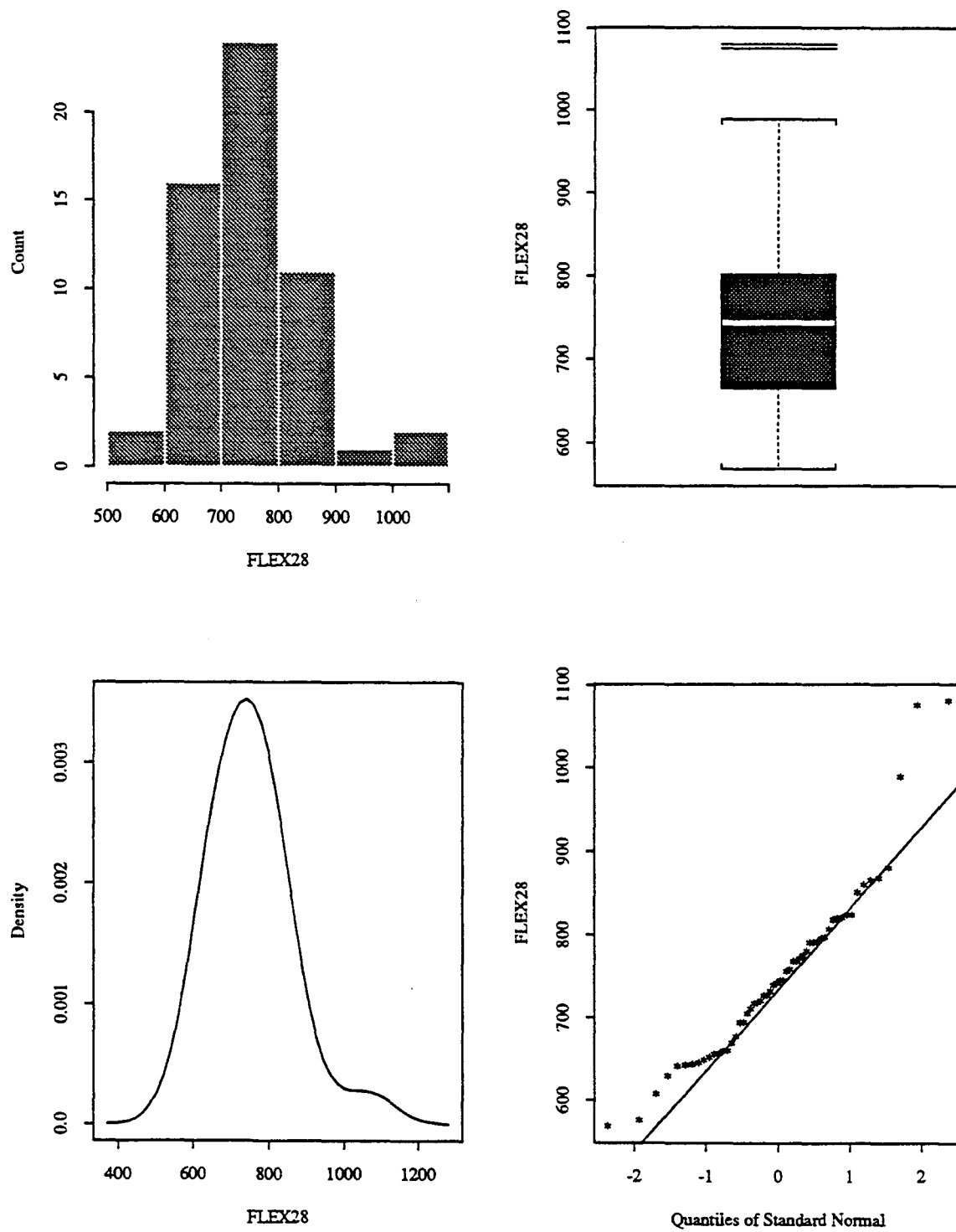


Figure 5.38 Statistical Distribution of 28-Day Flexural Strength for GPS-4 Sections, psi

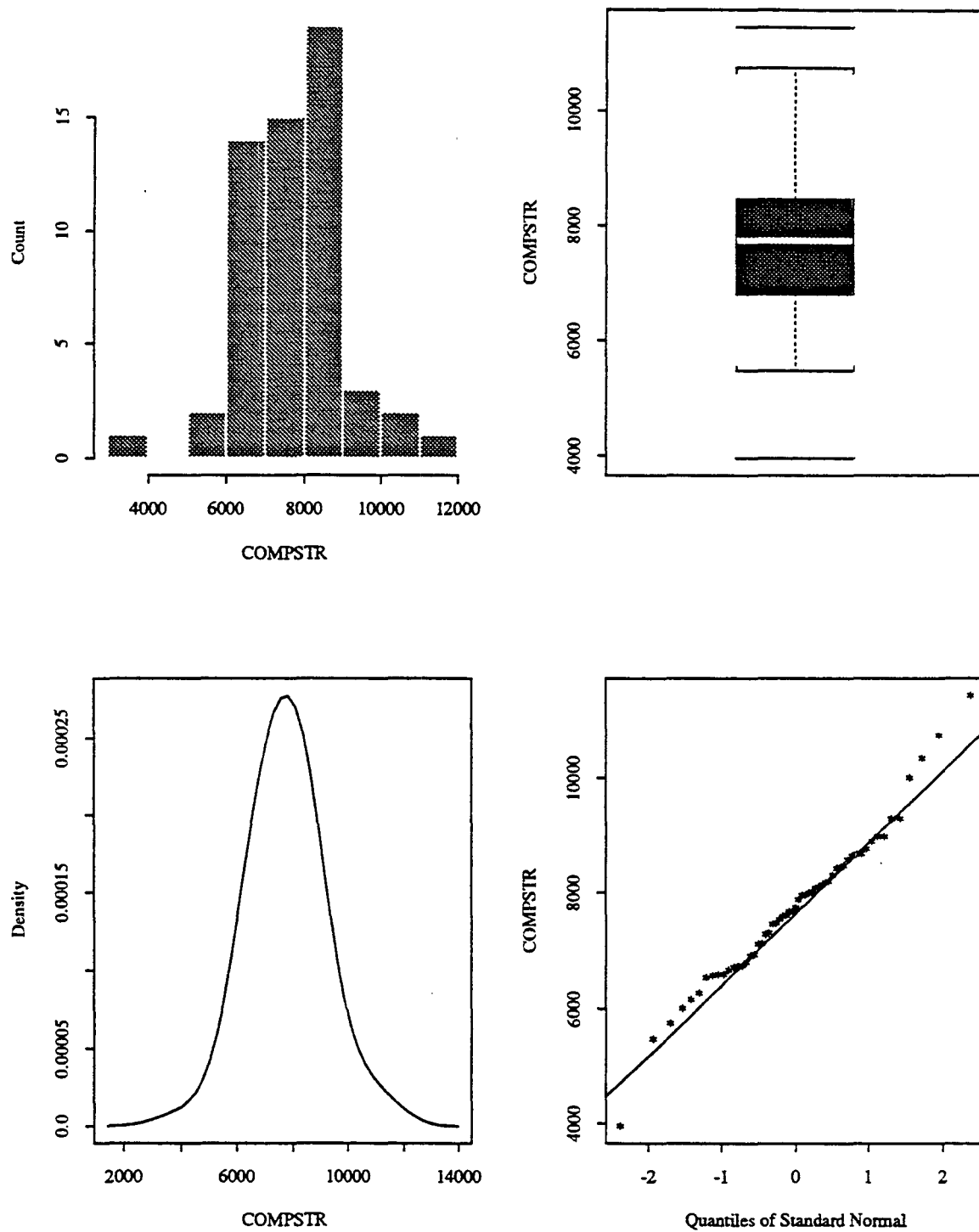


Figure 5.39 Statistical Distribution of Compressive Strength for GPS-4 Section, psi

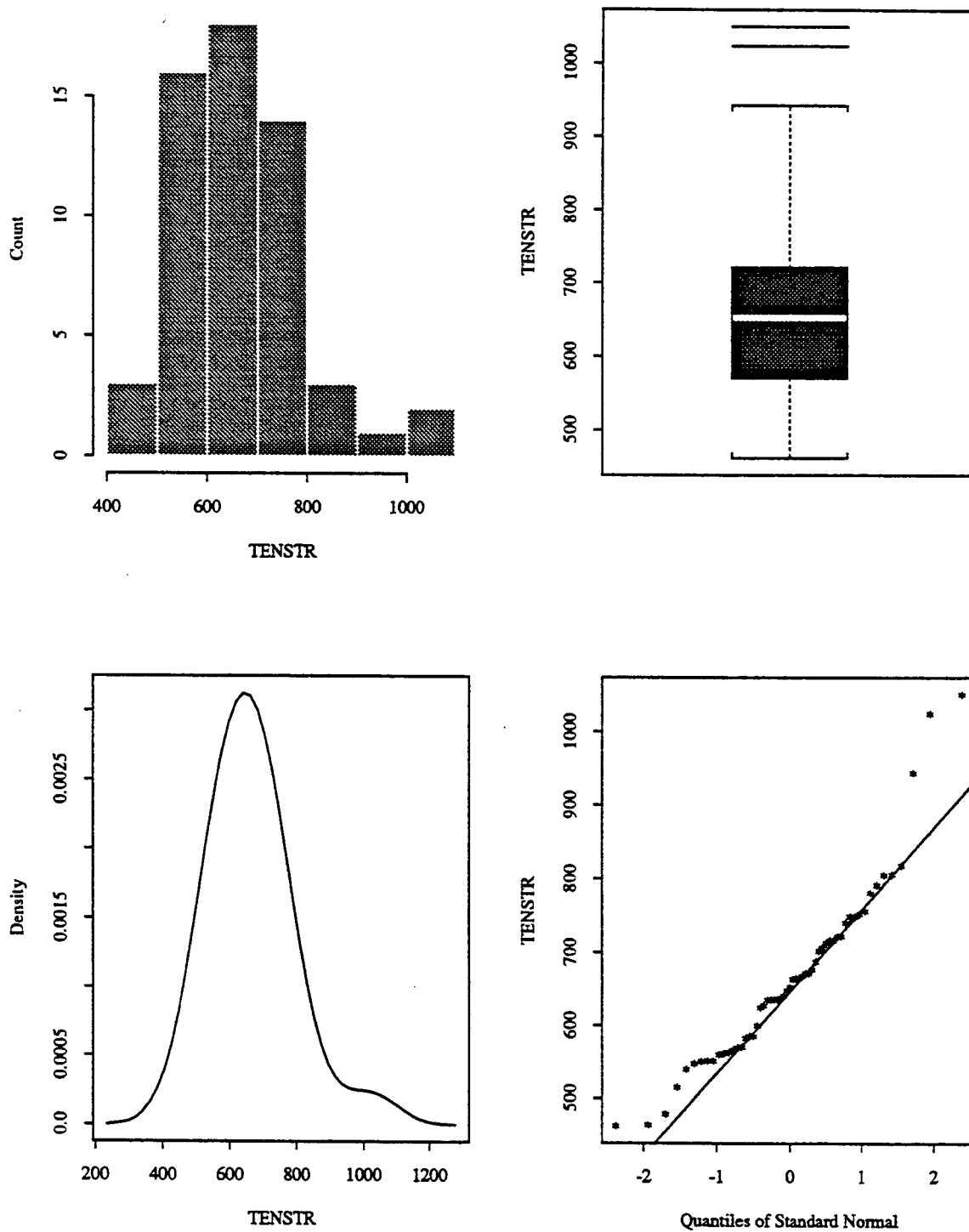


Figure 5.40 Statistical Distribution of Split Tensile Strength for GPS-4 Section, psi

Statistical Data for GPS-5 Test Sections

Statistical information on the 86 GPS 5 concrete pavement test sections for which data was available is provided in this chapter. The information includes statistical information on the key distress/roughness variables, and the significant variables of interest for the GPS-5 pavement sections. Specifically, they include tables that give information on the number of sections for each variable for which data was available, the mean, standard deviation, the minimum value, the median value, the maximum value, and range of the variable. A table that shows the correlations between the various significant variables, distresses, and roughness is also provided.

In addition, a number of plots are also provided that show the distribution of the various variables, distresses, and roughness. For each significant variable or distress/roughness a histogram, boxplot, probability density plot, and normal quantile-quantile plot are provided. For some of these variables or distresses/roughness, histograms that show their distribution by the four SHRP climatic regions, and scatter plots that show the relationship between the variable or distress/roughness and other selected variables or distresses/roughness, are also provided. For brevity, this latter information is not provided for all the variables or distresses/roughness.

Table 6.1 shows the number of test sections in each cell of the sampling template for the GPS-5 experiment. Environmental factors are defined in Figure 2.2 of Chapter 2. Other factors are summarized as follows:

Traffic Rate:	L - Less than 300 KESAL/Yr. H - Greater than or equal to 300 KESAL/Yr.
Percent Reinforcing:	L - Less than or equal to 0.61% H - Greater than 0.61%
PCC Thickness:	L - Less than 8.5 inches (210 mm) H - Greater than or equal to 8.5 inches (210 mm)

Table 6.4 relates the variable names used in the correlation table and statistical plots to variable descriptions.

Table 6.1 Number of Test Sections in Each Cell of the GPS-5 Sampling Template

Moisture		Wet								Dry							
Temperature		Freeze				No Freeze				Freeze				No Freeze			
Subgrade Type		F		C		F		C		F		C		F		C	
Traffic Rate		L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H
PCC Thickness	% Reinforcement	Number of CRCP Sections in the Data Set															
L	L	3	2	2	2	2	3	2	3	2	1	1		2	3	2	1
	H	2	2	2	1	2	2	2		2	1		1				
H	L	2	2	1	2	2	2		1					2	3	2	1
	H	2	2	1	1		2	2	2				1				

Table 6.2 Statistical Values for Roughness Variables in the GPS-5 Data Set.

Variable	Units	Sections With distress	Mean	Standard Deviation	Low Value	Median Value	High Value	Range	
IRI:	Left Wheelpath:	Inches/mile	82	97.85	27.73	46.63	96.72	159.90	113.27
	Right Wheelpath:	Inches/mile	82	97.28	30.10	52.94	91.67	178.40	125.46
	Average IRI:	Inches/mile	82	97.56	27.95	49.79	92.98	160.40	110.61
Slope Variance:	Left Wheelpath:		82	5.04	2.59	1.70	4.43	12.76	11.06
	Right Wheelpath:		82	4.77	2.80	1.44	4.44	19.62	18.18
	Average Slope Variance:		82	4.90	2.37	1.73	4.34	12.07	10.34

Table 6.3 Statistical Values of Interest for Significant Variables in the GPS-5 Data Set

Variable	Units	No. of Values	Mean Value	Standard Deviation	Low Value	Median Value	High Value	Range
PCC Thickness	Inches	69	8.74	1.19	6.25	8.30	12.78	6.53
Base Thickness	Inches	85	4.80	2.57	0.00	4.00	20.00	20.00
Subbase Thickness	Inches	85	3.92	5.09	0.00	4.00	24.00	24.00
KESALs Per Year	No.	76	492.7	588.2	0	368	3506	3506
Pavement Age	Years	80	14.3	6.6	0.6	15.8	28.1	27.5
Air Freeze-Thaw Cycles	No.	86	70.6	29.3	8	75	155	147
Freezing Index	Degree Days	86	433.0	519.4	0	198	2339	2339
No. of Days Temp. > 90°F	No.	86	42.9	32.9	4	32	182	178
No. of Days Temp. < 32°F	No.	86	84.3	45.2	6	81	181	175
Average Min. Temp. by Month	°F	86	21.54	10.49	-3.81	22.62	41.03	44.84
Average Max. Temp. by Month	°F	86	90.11	4.81	81.15	89.54	107.20	26.05
Average Monthly Precipitation	Inches	86	3.15	1.07	0.58	3.19	5.53	4.95
Average Yearly Precipitation	Inches	86	37.78	12.89	7.0	38.4	66.4	59.4
Wet Days in Year	No.	86	118.6	29.0	42	120	171	129
Backcalculated Static k-value	pci	69	172.1	113.1	70.38	145.10	838.40	768.02
PCC Elastic Modulus	x 10 ⁶ psi	69	4.58	0.87	2.70	4.55	6.72	4.02
PCC 28-day Flexural Strength	psi	67	767.6	92.5	589	762	1005	416

Table 6.3. Statistical Values of Interest for Significant Variables in the GPS-5 Data Set

Variable	Units	No. of Values	Mean Value	Standard Deviation	Low Value	Median Value	High Value	Range
PCC Compressive Strength	psi	68	7621	1261	4860	7615	11310	6450
PCC Indirect Tensile Strength	psi	70	680.8	97.9	489	672	926	437
Steel Yield Strength	ksi	70	60.49	5.66	40.0	60.0	76.9	36.9
Depth to Steel	Inches	80	3.77	0.72	2.3	3.8	5.5	3.2

Table 6.4 Nomenclature Used for Correlation Table and Statistical Plots

Variable	Description of Variable
AVE.IRI or IRI	Measured average IRI value, inches/mile
AVE.SV or SLPVAR	Measured average slope variance
THICK	Measured PCC layer thickness, inches
BASETHK	Measured base thickness, inches
SBASETHK	Measured subbase thickness, inches
YRL.KESAL or YRKESAL	Cumulative 18-kip ESALs per year, thousands
AGE	Pavement age, years
FT	Average number of air freeze-thaw cycles
FI	Freezing index, degree days
DAYS90	Number of days with temperature greater than 90°F
DAYS32	Number of days with temperature lower than 32°F
MAXTEMP	Average monthly maximum temperature, °F
MINTEMP	Average monthly minimum temperature, °F
YRL.PRECIP or YRPRECIP	Average precipitation by year, inches
PRECIP	Average precipitation by month, inches
DAYSWET	Average number of wet days
KSTATIC	Backcalculated modulus of subgrade reaction, psi/inch
EPCC	Measured PCC layer elastic modulus, psi
FLEX28	PCC layer 28-day flexural strength, psi
COMPSTR	PCC layer compressive strength, psi
TENSTR	PCC layer indirect (split) tensile strength, psi
YLDSTR	Steel yield strength, psi
STLDEPTH	Depth to steel reinforcement, inches

Table 6.5 Correlation Matrix for Significant Variables in the GPS-5 Data Set

	IRI	SLPVAR	THICK	BASETHK	SBASETHK	YRKESAL	FT	FI	DAYS90	DAYS32	MAXTEMP	MINTEMP	PRECIP
IRI	1.000	0.725	0.111	-0.219	0.186	-0.156	-0.188	-0.057	0.402	-0.131	0.359	0.122	-0.035
SLPVAR	0.725	1.000	0.239	-0.064	0.432	-0.073	-0.057	-0.054	0.331	-0.050	0.296	0.031	-0.152
THICK	0.111	0.239	1.000	0.375	-0.014	0.499	-0.199	-0.179	-0.061	-0.227	-0.178	0.194	0.084
BASETHK	-0.219	-0.064	0.375	1.000	-0.216	0.630	0.025	-0.117	-0.407	-0.054	-0.485	0.084	0.214
SBASETHK	0.186	0.432	-0.014	-0.216	1.000	-0.184	-0.313	-0.158	0.484	-0.268	0.465	0.226	-0.117
YRKESAL	-0.156	-0.073	0.499	0.630	-0.184	1.000	-0.016	-0.172	-0.357	-0.111	-0.455	0.153	0.078
FT	-0.188	-0.057	-0.199	0.025	-0.313	-0.016	1.000	0.675	-0.628	0.950	-0.514	-0.875	-0.497
FI	-0.057	-0.054	-0.179	-0.117	-0.158	-0.172	0.675	1.000	-0.566	0.866	-0.516	-0.920	-0.357
DAYS90	0.402	0.331	-0.061	-0.407	0.484	-0.357	-0.628	-0.566	1.000	-0.645	0.966	0.608	-0.034
DAYS32	-0.131	-0.050	-0.227	-0.054	-0.268	-0.111	0.950	0.866	-0.645	1.000	-0.544	-0.972	-0.477
MAXTEMP	0.359	0.296	-0.178	-0.485	0.465	-0.455	-0.514	-0.516	0.966	-0.544	1.000	0.514	-0.086
MINTEMP	0.122	0.031	0.194	0.084	0.226	0.153	-0.875	-0.920	0.608	-0.972	0.514	1.000	0.447
PRECIP	-0.035	-0.152	0.084	0.214	-0.117	0.078	-0.497	-0.357	-0.034	-0.477	-0.086	0.447	1.000
YRPRECIP	-0.036	-0.152	0.084	0.213	-0.117	0.078	-0.497	-0.357	-0.033	-0.478	-0.085	0.448	1.000
DAYSWET	-0.105	-0.183	0.269	0.482	-0.300	0.483	-0.133	-0.067	-0.497	-0.129	-0.560	0.131	0.651
KSTATIC	0.003	-0.072	-0.163	-0.045	0.133	-0.061	-0.162	-0.160	0.355	-0.176	0.336	0.145	-0.085
EPCC	0.289	0.253	0.009	-0.173	0.403	-0.040	-0.229	-0.031	0.307	-0.160	0.252	0.165	0.106
COMPSTR	0.057	0.156	0.092	0.080	0.112	0.090	-0.035	0.105	-0.041	0.009	-0.083	0.007	0.152
YLDSTR	0.114	0.041	-0.060	-0.106	-0.076	-0.220	0.247	0.352	-0.154	0.310	-0.078	-0.365	-0.276
STLDEPTH	0.333	0.274	0.534	-0.119	0.248	0.091	-0.436	-0.462	0.381	-0.468	0.303	0.456	0.084

Table 6.5 Correlation Matrix for Significant Variables in the GPS-5 Data Set

	YRPRECIP	DAYSWET	KSTATIC	EPCC	COMPSTR	YLDSTR	STLDEPTH
IRI	-0.036	-0.105	0.003	0.289	0.057	0.114	0.333
SLPVAR	-0.152	-0.183	-0.072	0.253	0.156	0.041	0.274
THICK	0.084	0.269	-0.163	0.009	0.092	-0.060	0.534
BASETHK	0.213	0.482	-0.045	-0.173	0.080	-0.106	-0.119
SBASETHK	-0.117	-0.300	0.133	0.403	0.112	-0.076	0.248
YRKESAL	0.078	0.483	-0.061	-0.040	0.090	-0.220	0.091
FT	-0.497	-0.133	-0.162	-0.229	-0.035	0.247	-0.436
FI	-0.357	-0.067	-0.160	-0.031	0.105	0.352	-0.462
DAYS90	-0.033	-0.497	0.355	0.307	-0.041	-0.154	0.381
DAYS32	-0.478	-0.129	-0.176	-0.160	0.009	0.310	-0.468
MAXTEMP	-0.085	-0.560	0.336	0.252	-0.083	-0.078	0.303
MINTEMP	0.448	0.131	0.145	0.165	0.007	-0.365	0.456
PRECIP	1.000	0.651	-0.085	0.106	0.152	-0.276	0.084
YRPRECIP	1.000	0.651	-0.084	0.106	0.152	-0.275	0.085
DAYSWET	0.651	1.000	-0.227	-0.065	0.063	-0.181	-0.007
KSTATIC	-0.084	-0.227	1.000	-0.058	-0.214	0.029	0.016
EPCC	0.106	-0.065	-0.058	1.000	0.549	-0.251	0.168
COMPSTR	0.152	0.063	-0.214	0.549	1.000	-0.108	-0.048
YLDSTR	-0.275	-0.181	0.029	-0.251	-0.108	1.000	-0.152
STLDEPTH	0.085	-0.007	0.016	0.168	-0.048	-0.152	1.000

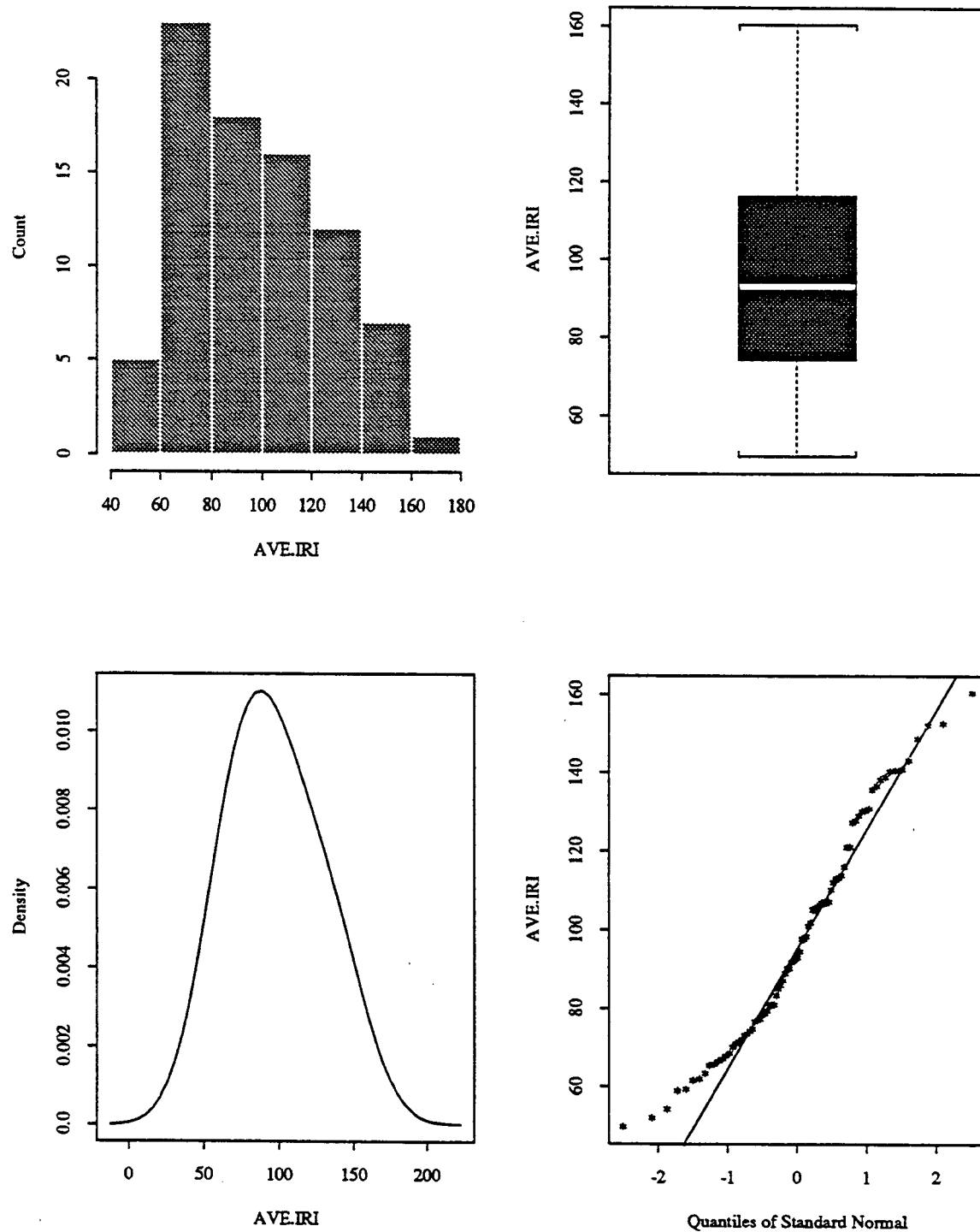


Figure 6.1 Statistical Distribution of Average IRI for GPS-5 Sections, In./Mile

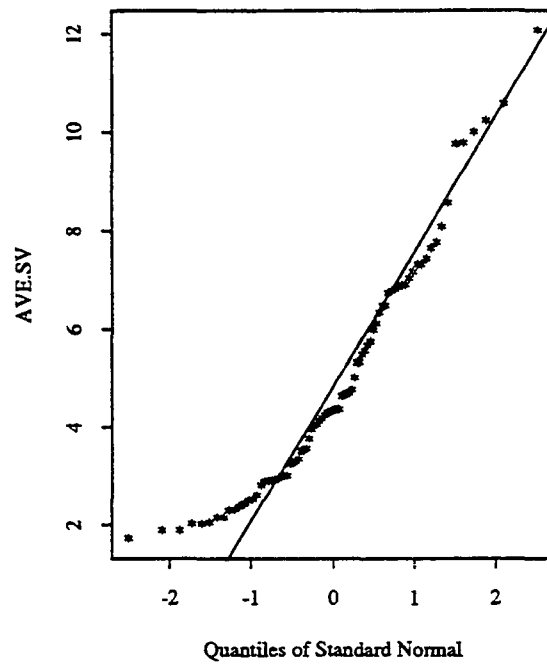
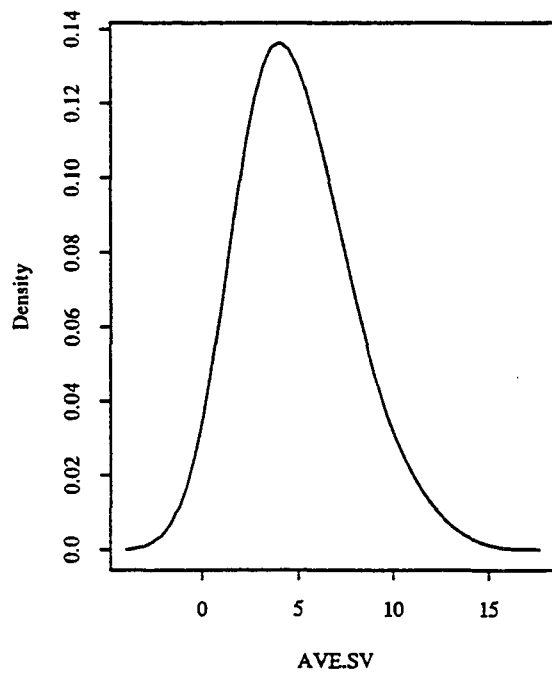
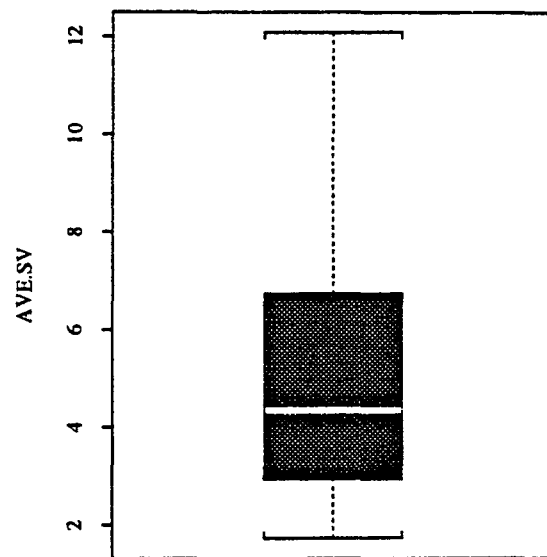
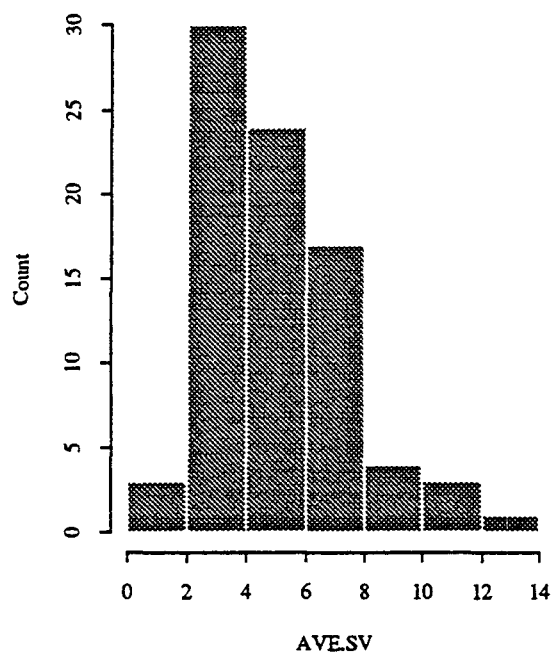


Figure 6.2 Statistical Distribution of Average Slope Variance for GPS-5 Sections

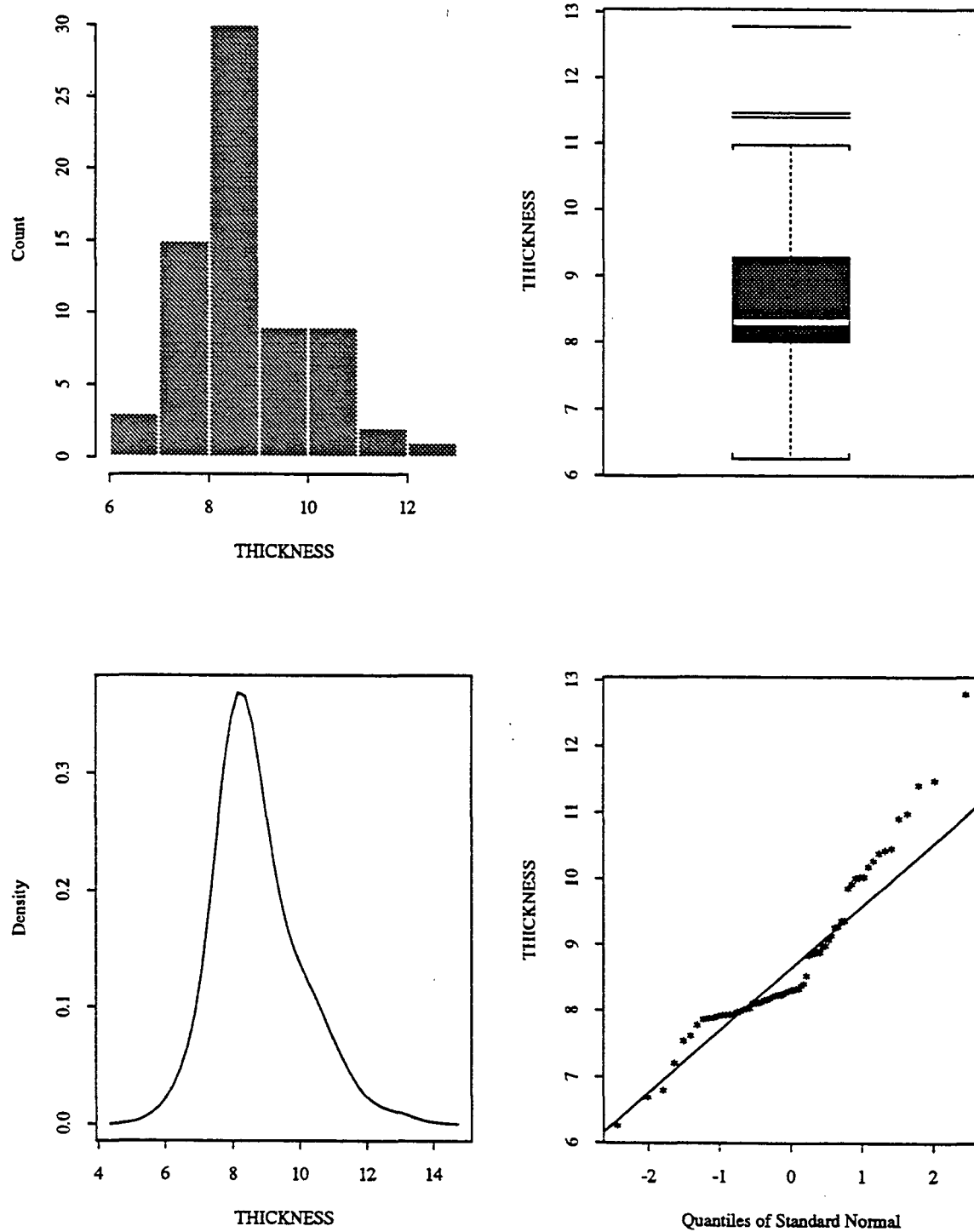


Figure 6.3 Statistical Distribution of PCC Thickness for GPS-5 Sections, In.

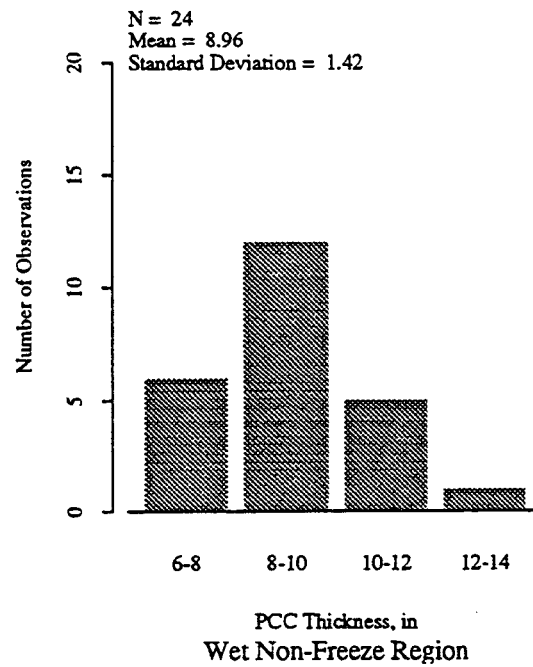
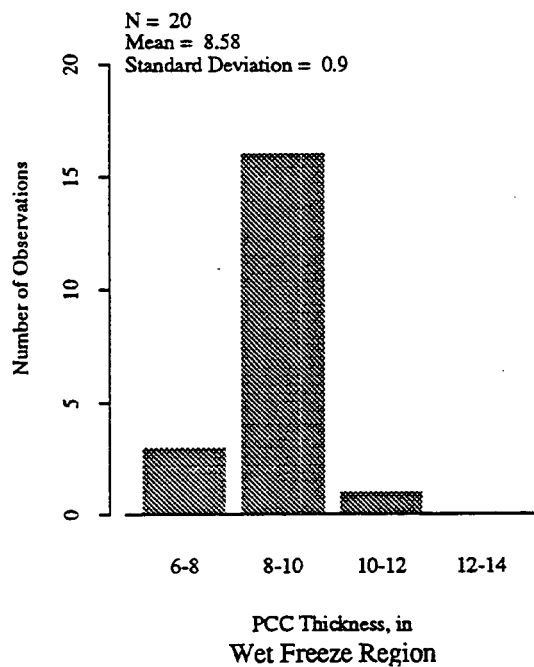
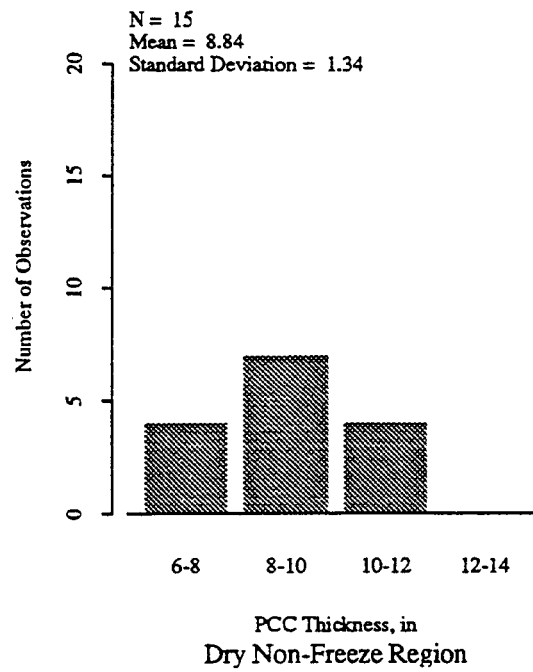
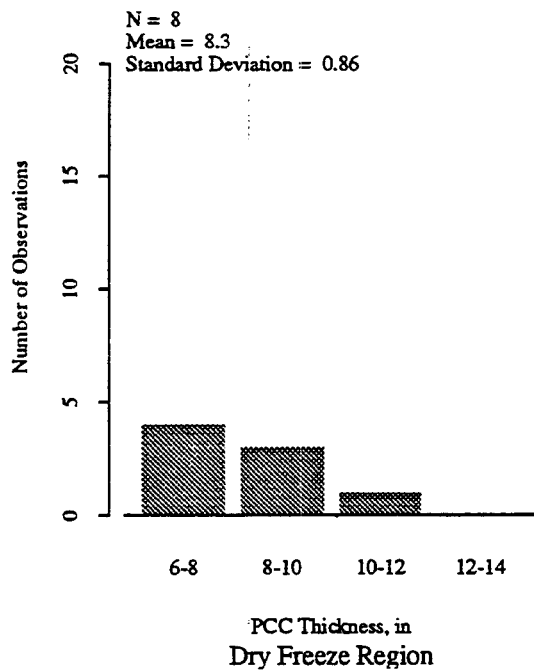


Figure 6.4 Distribution of PCC Thickness by Environmental Regions for GPS-5 Sections

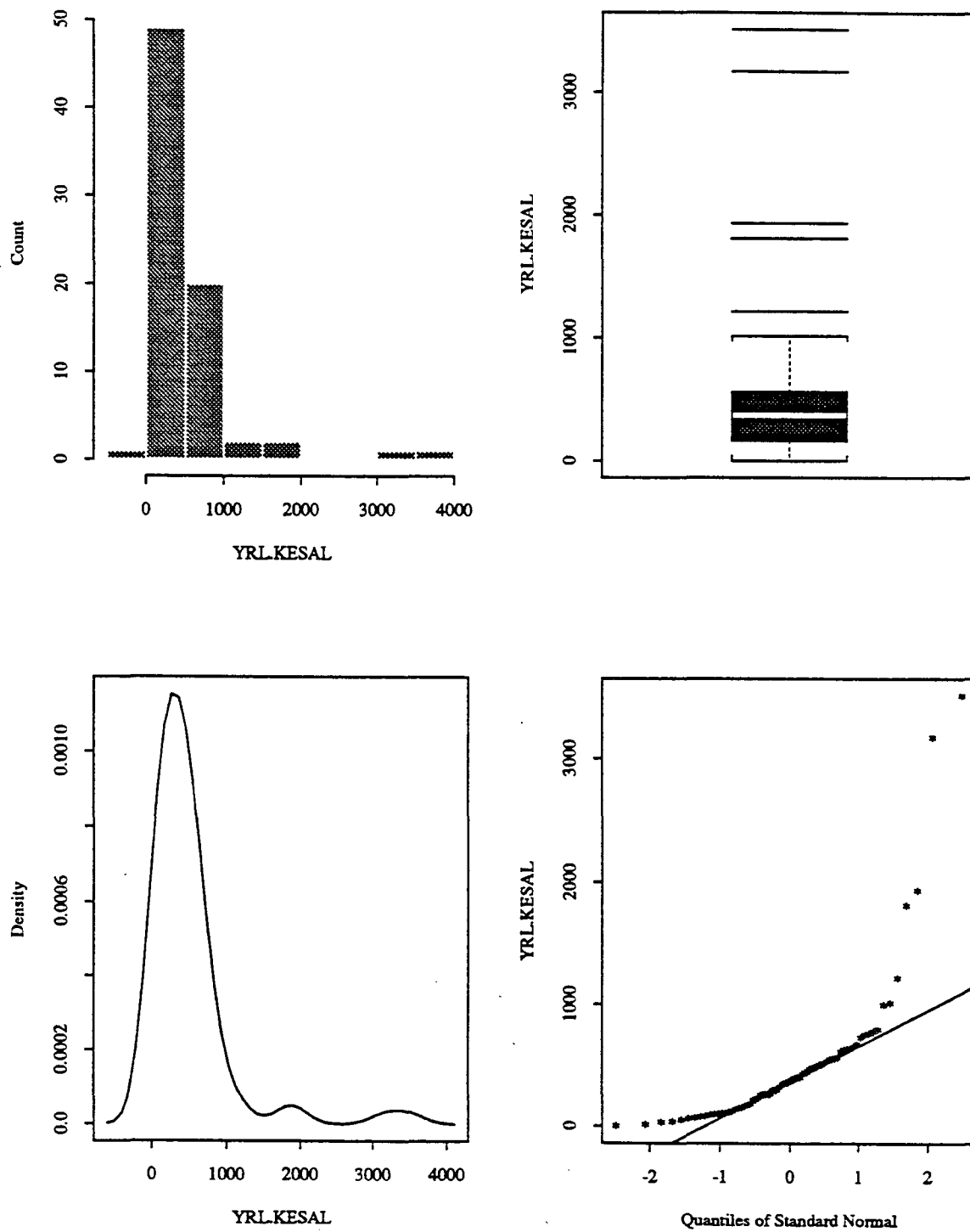


Figure 6.5 Statistical Distribution of KESALs/Year for GPS-5 Sections

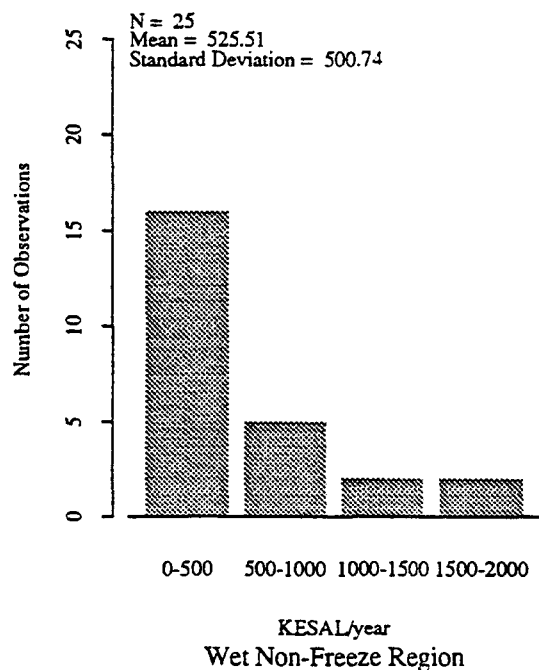
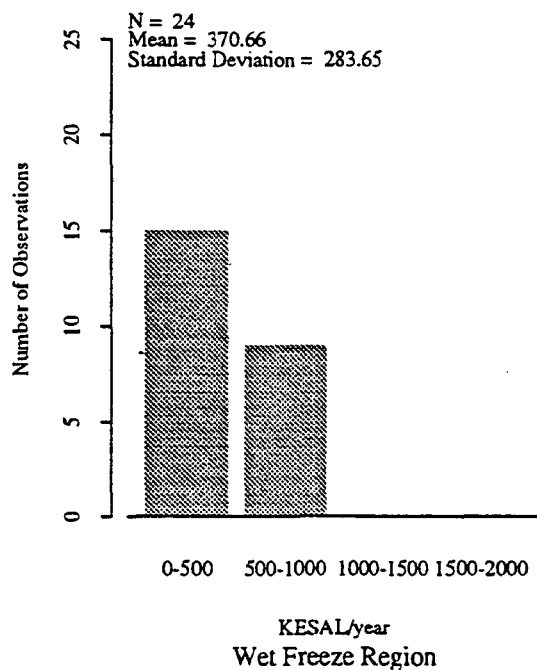
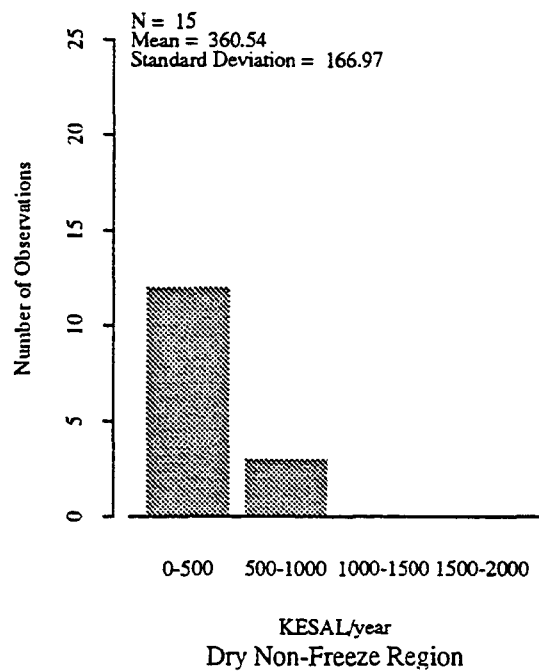
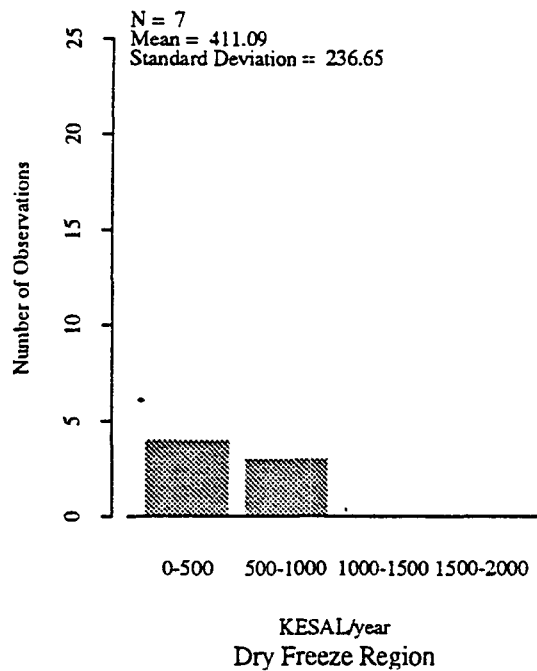


Figure 6.6 Distribution of KESALs/Year by Environmental Regions for GPS-5 Sections

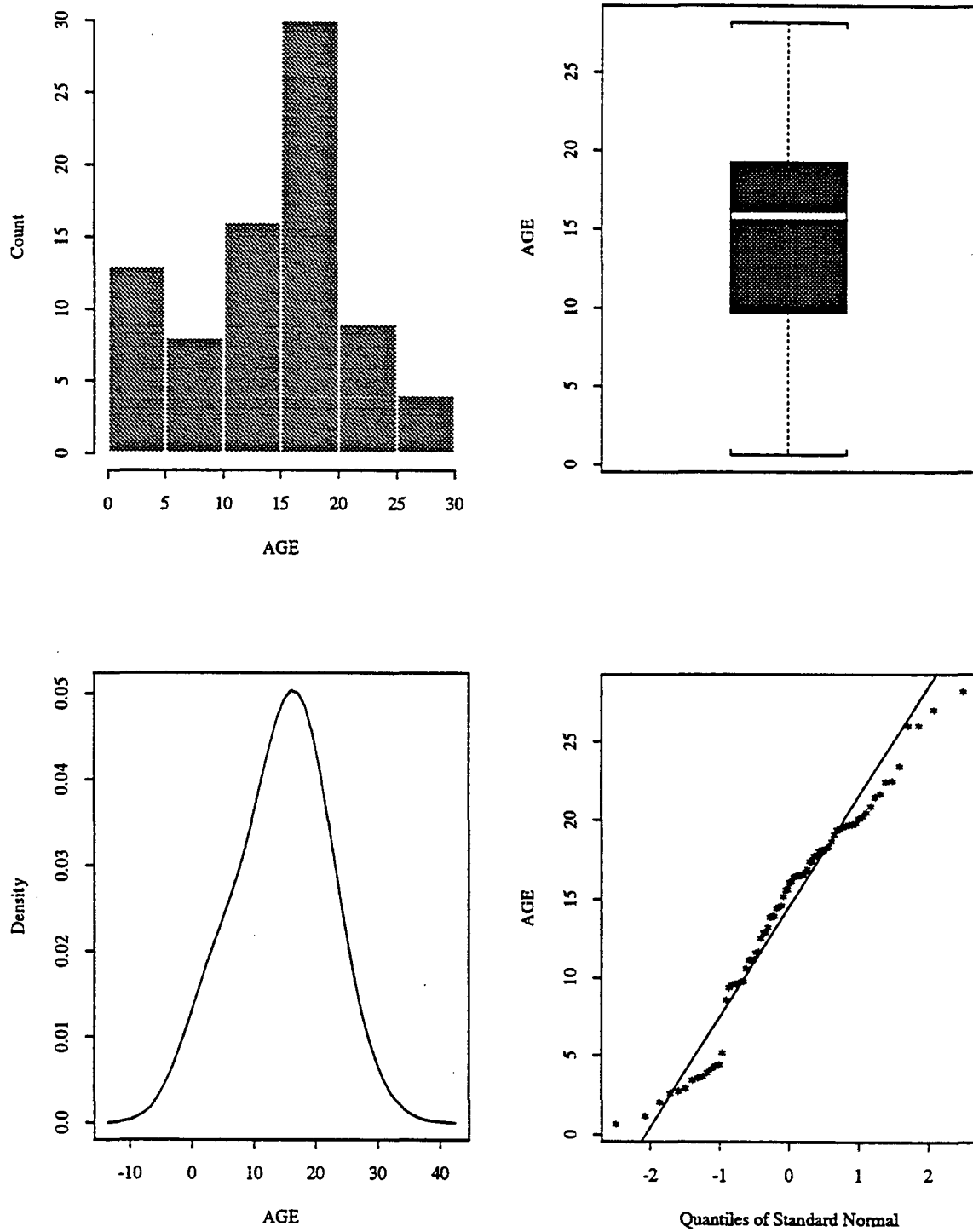


Figure 6.7 Statistical Distribution of Pavement Age for GPS-5 Sections, Years

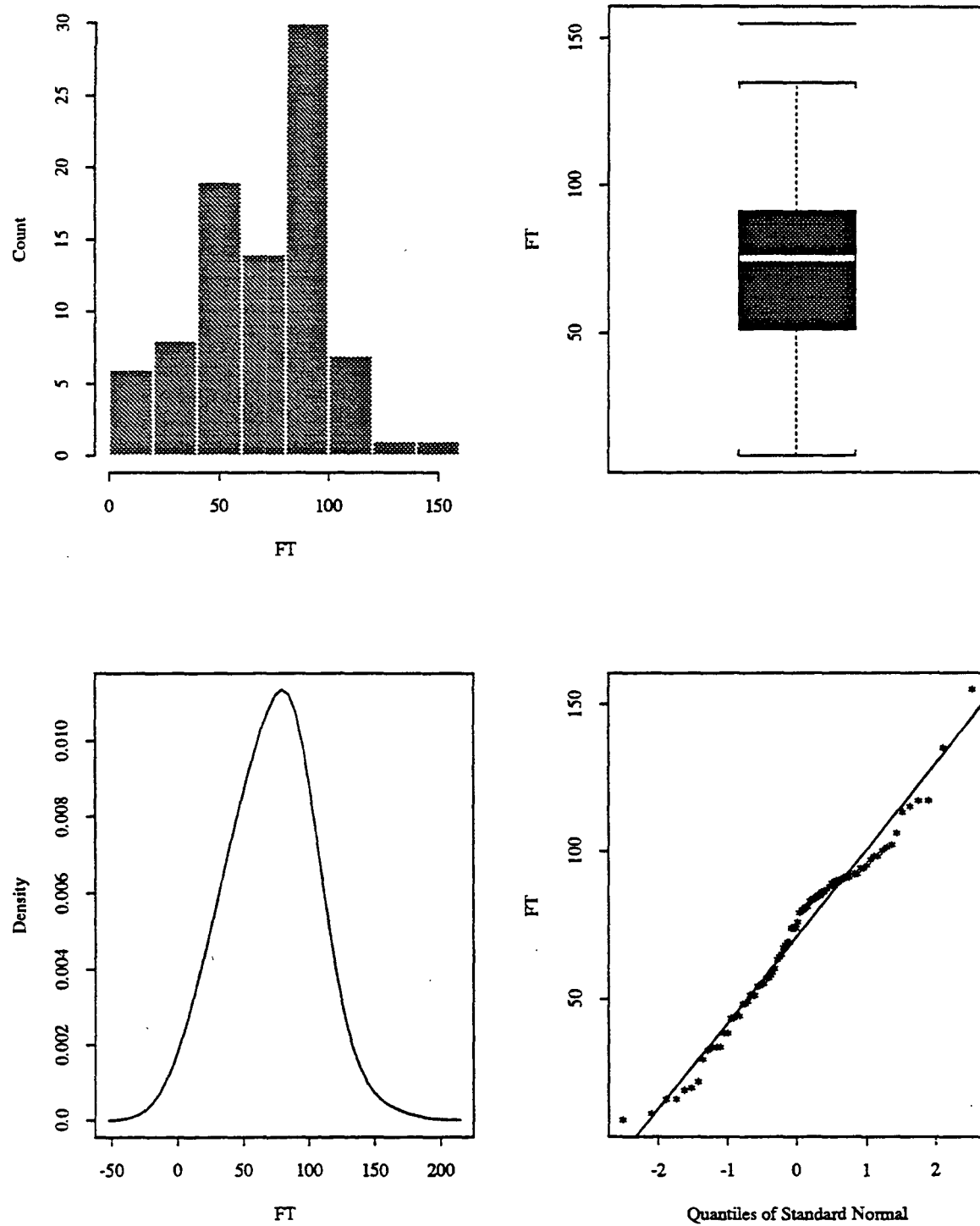


Figure 6.8 Statistical Distribution of Freeze-Thaw Cycles for GPS-5 Sections

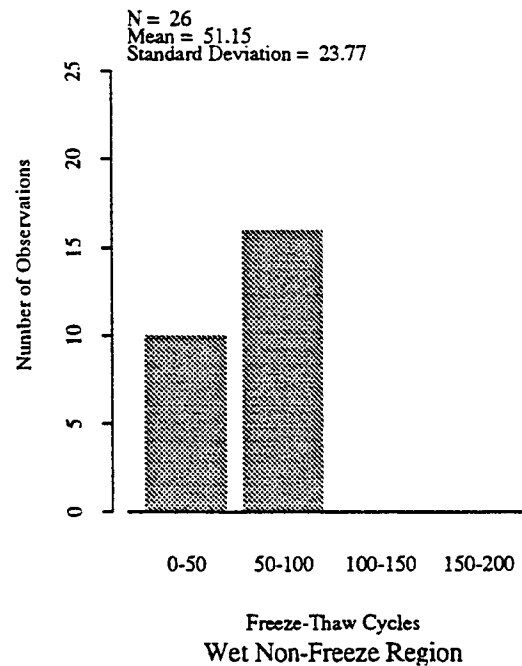
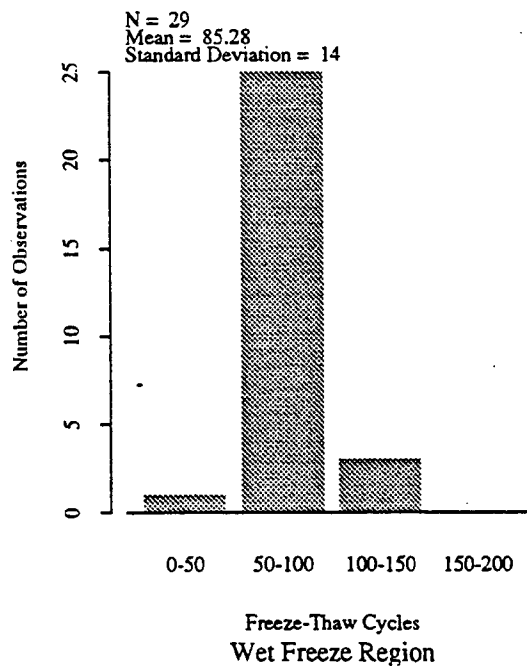
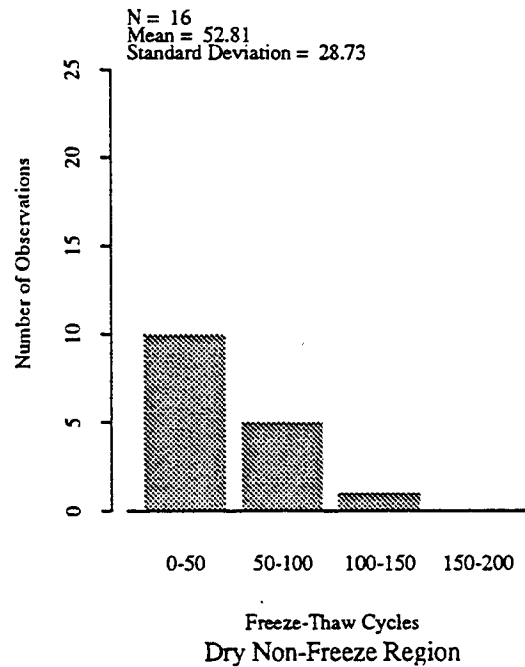
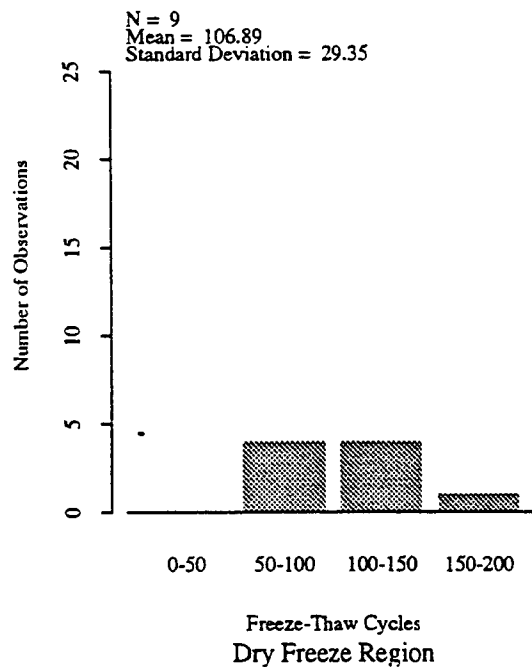


Figure 6.9 Distribution of Freeze-Thaw Cycles by Environmental Regions for GPS-5 Sections

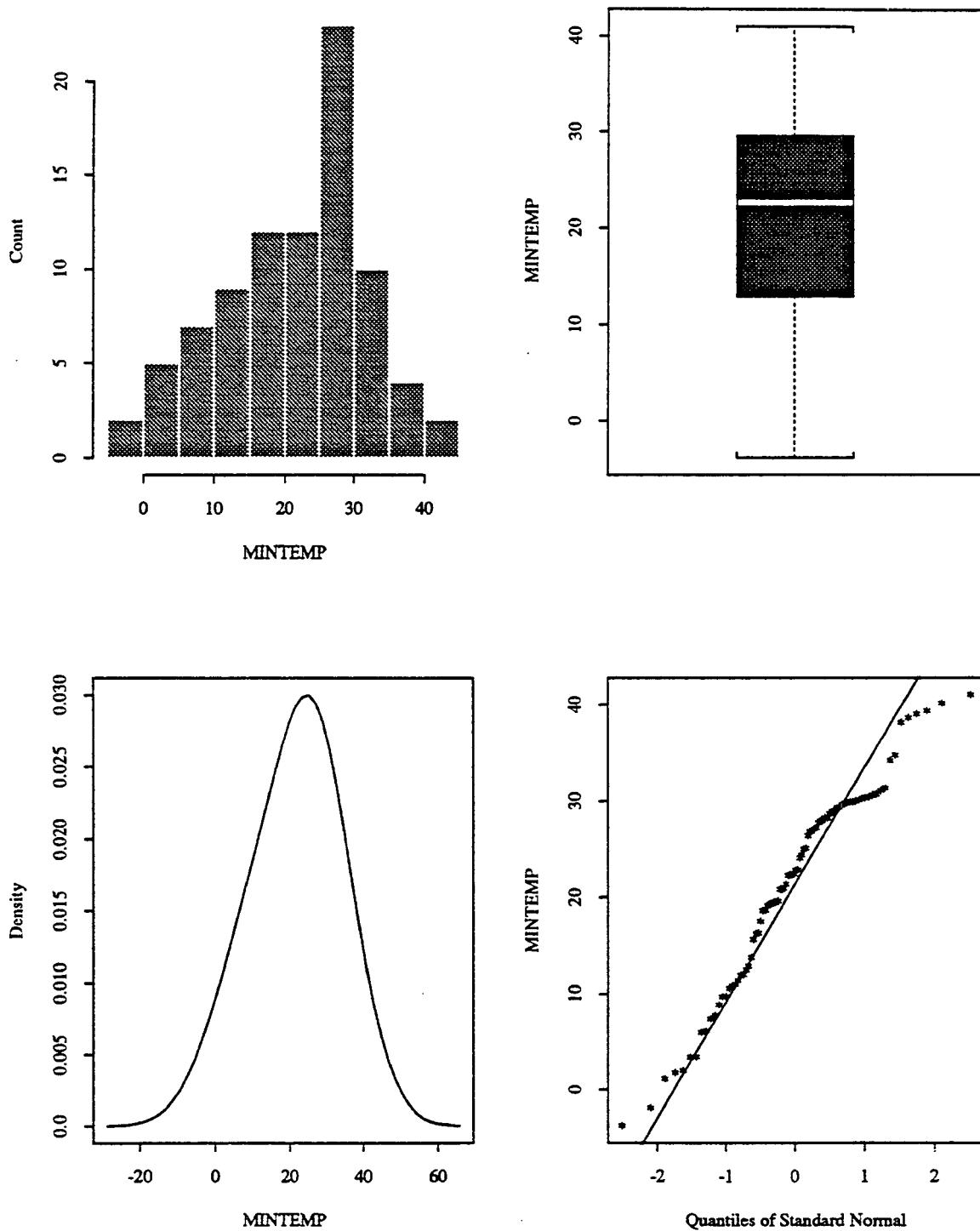


Figure 6.10 Statistical Distribution of Average Monthly Minimum Temperature for GPS-5 Sections, °F

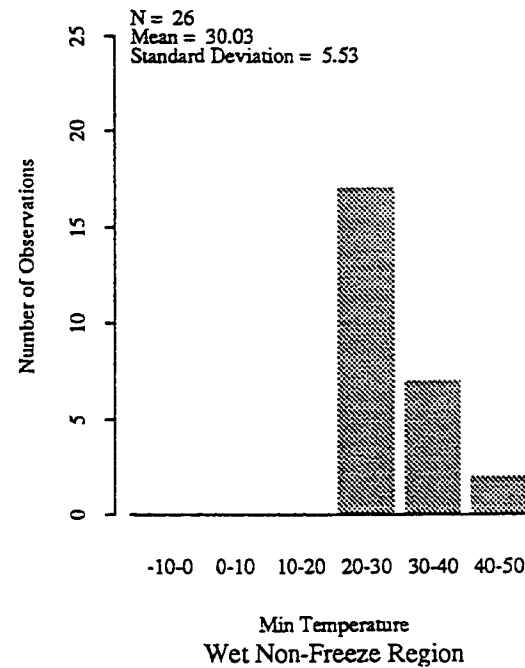
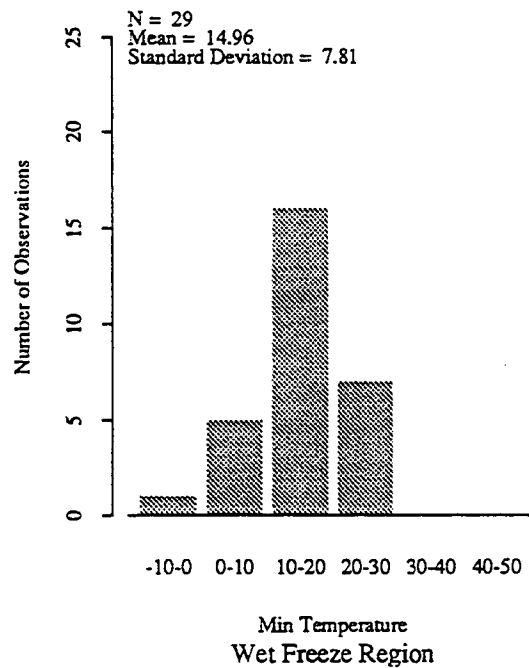
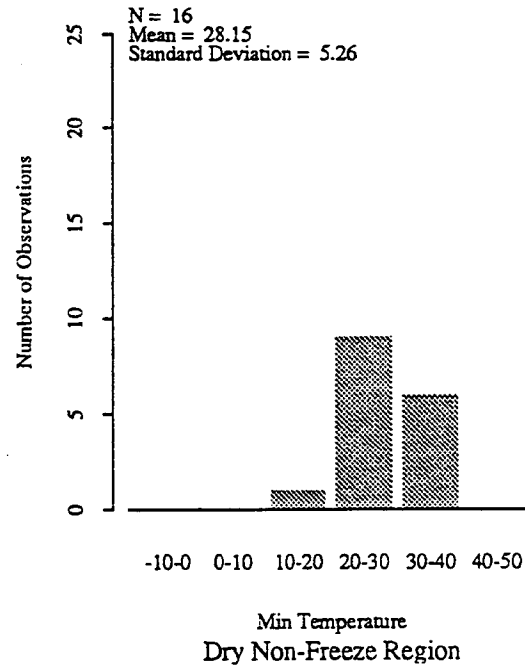
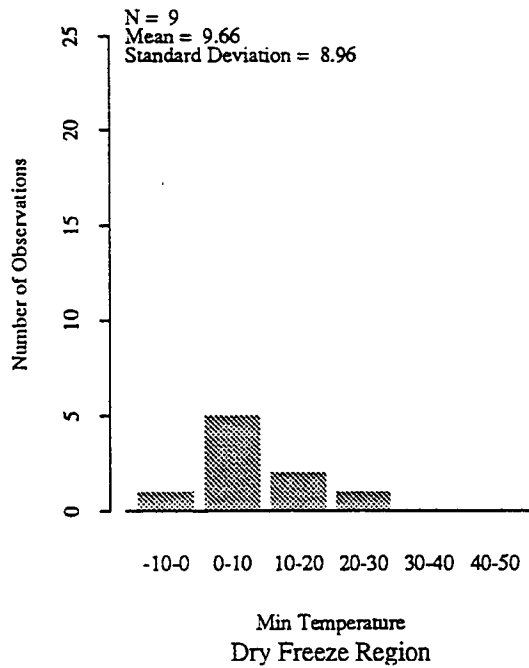


Figure 6.11 Distribution of Minimum Temperature by Environmental Regions for GPS-5 Sections, °F

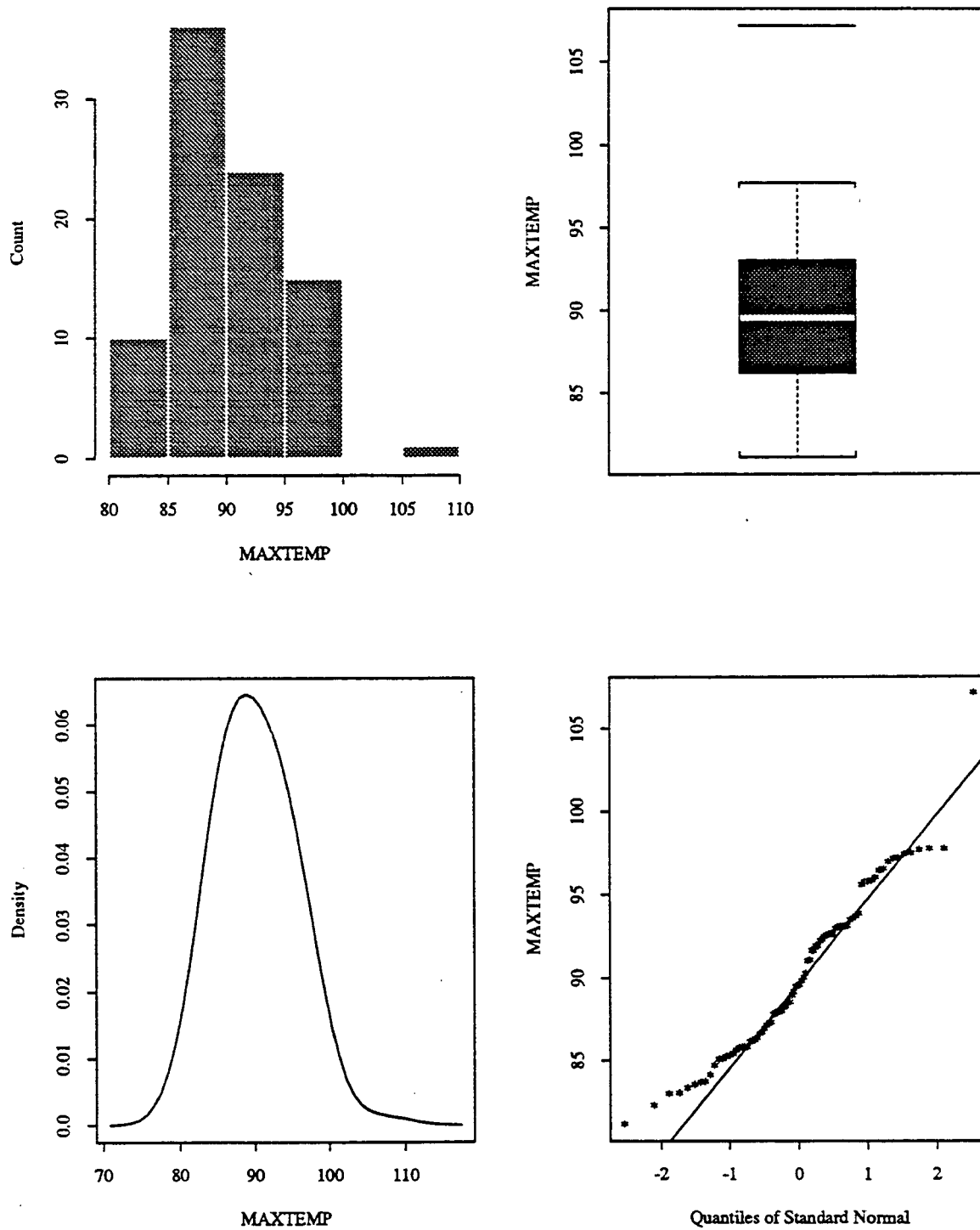


Figure 6.12 Statistical Distribution of Average Monthly Maximum Temperature for GPS-5 Sections, °F

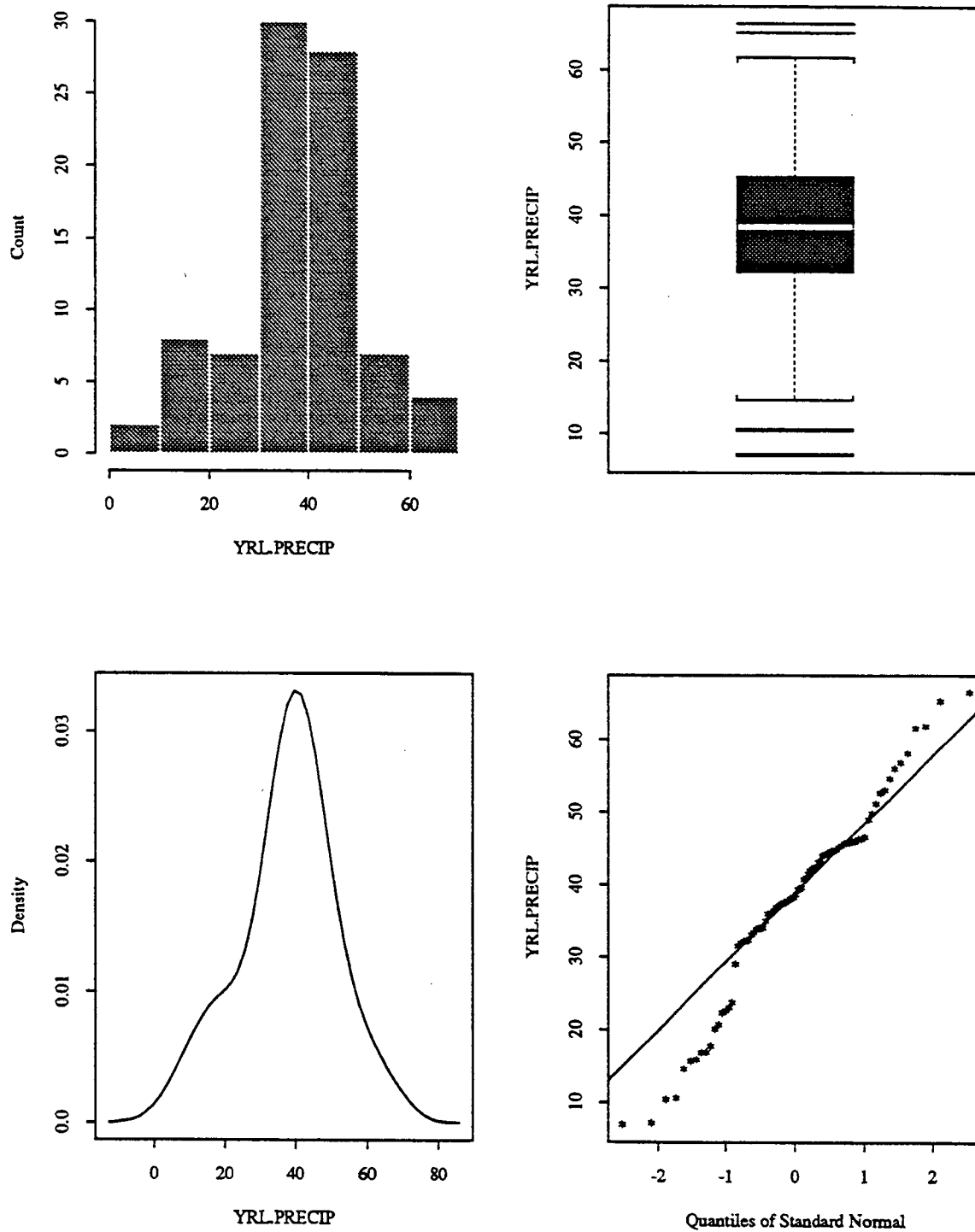


Figure 6.13 Statistical Distribution of Average Yearly Precipitation for GPS-5 Sections, Inches

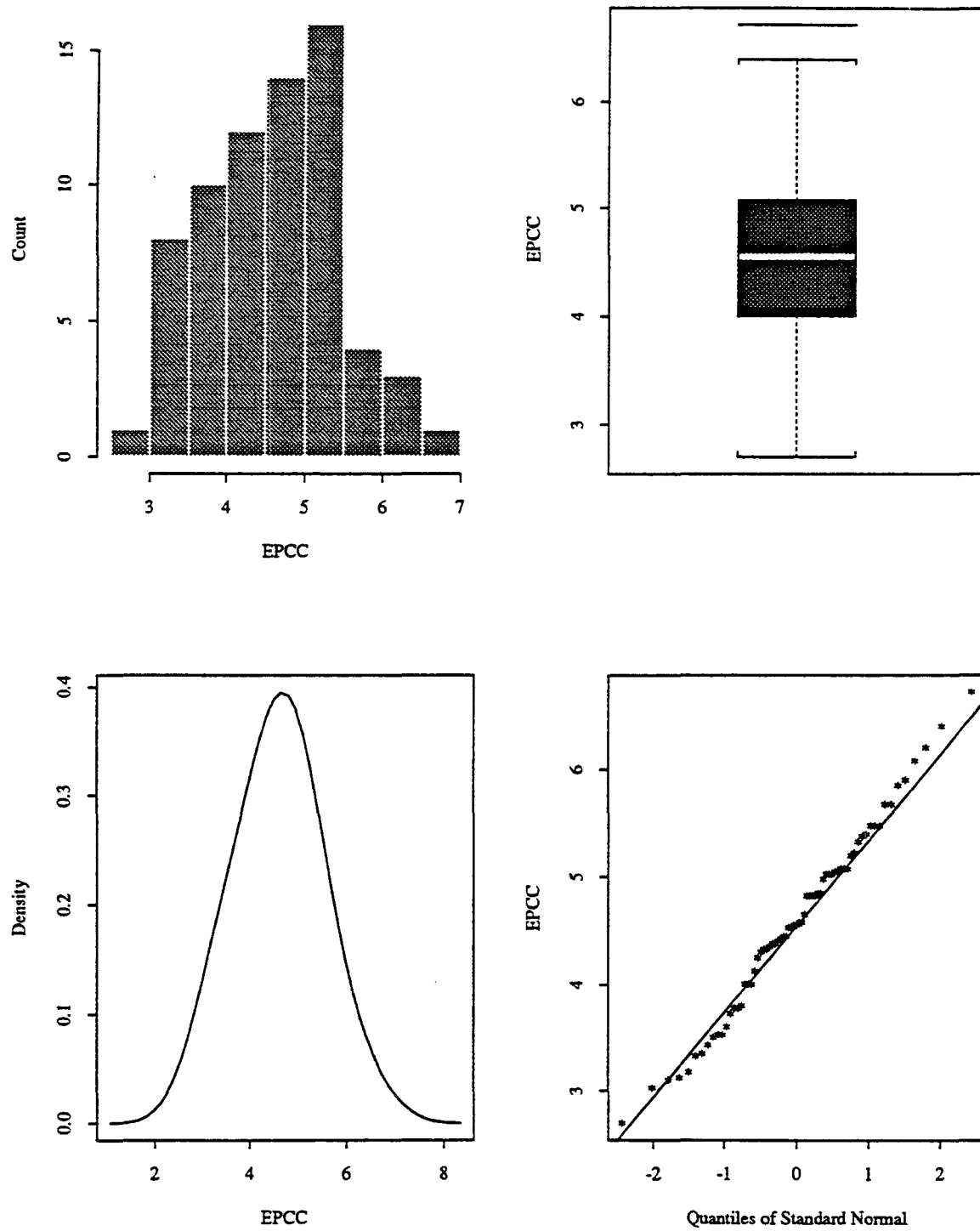


Figure 6.14 Statistical Distribution of PCC Elastic Modulus for GPS-5 Sections, Million, psi

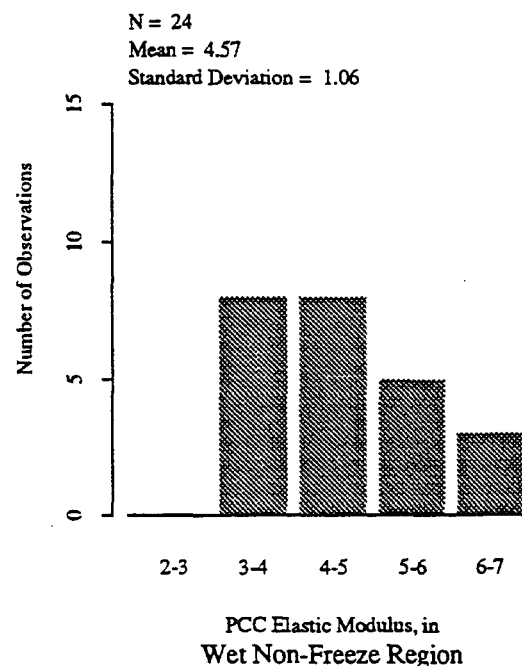
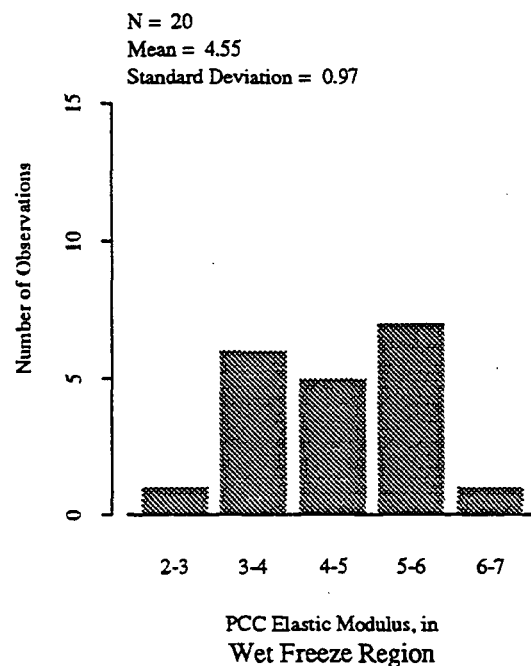
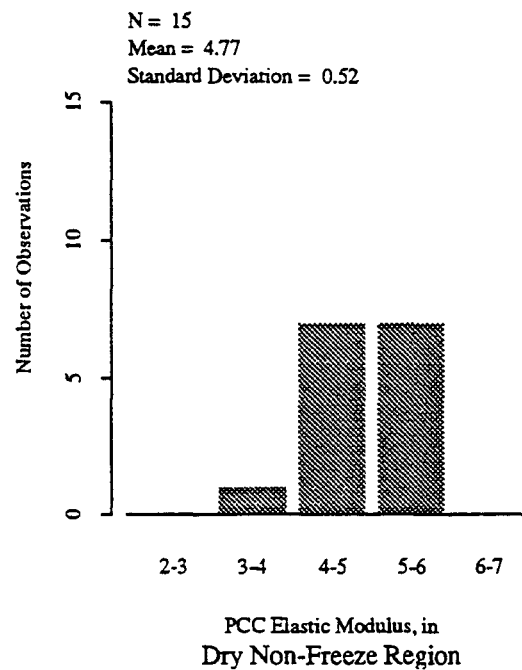
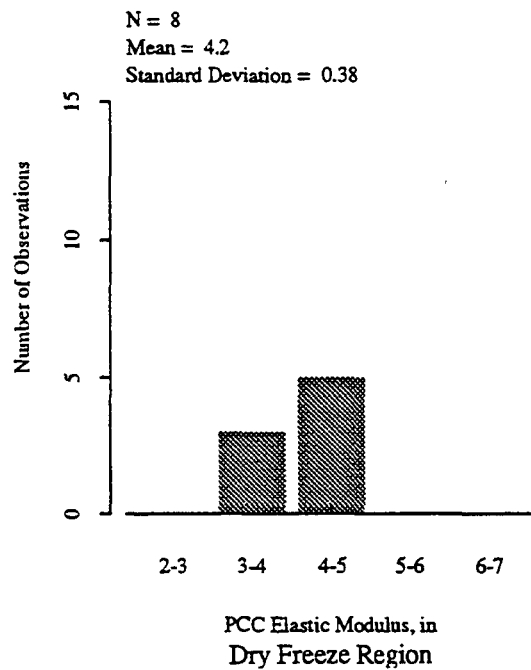


Figure 6.15 Distribution of PCC Elastic Modulus by Environmental Regions for GPS-5 Sections

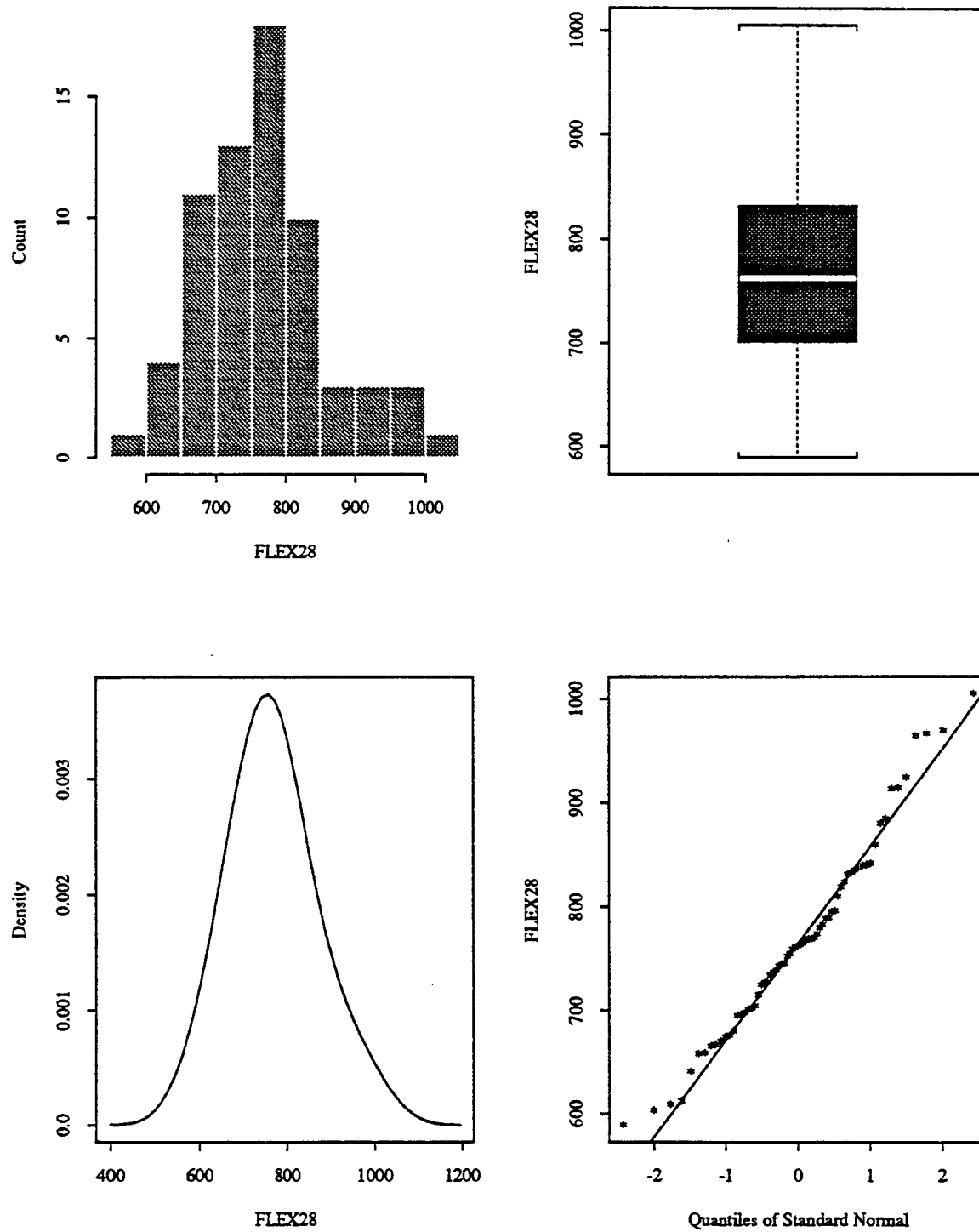


Figure 6.16 Statistical Distribution of 28-Day Flexural Strength for GPS-5 Sections, psi

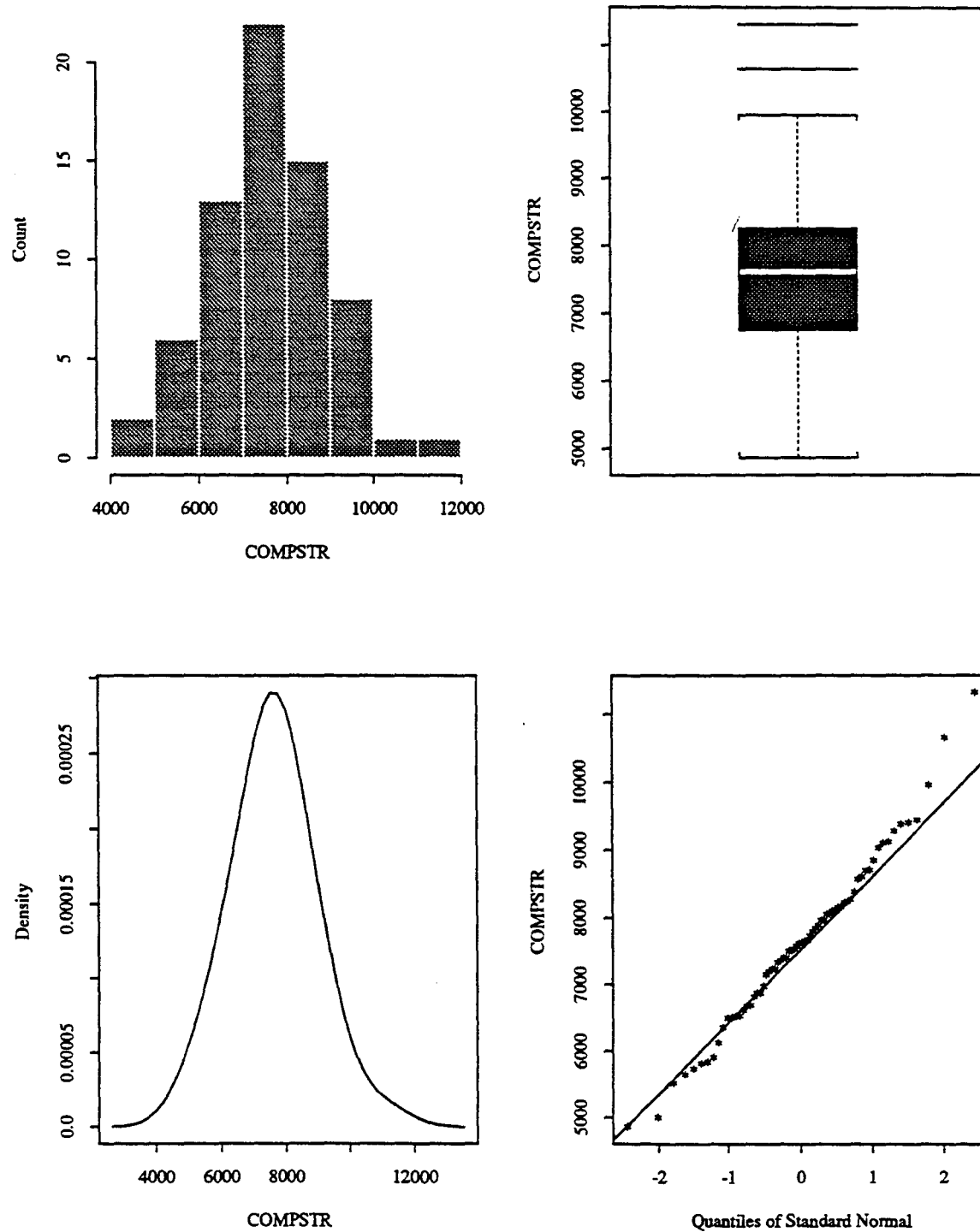


Figure 6.17 Statistical Distribution of Compressive Strength for GPS-5 Sections, psi

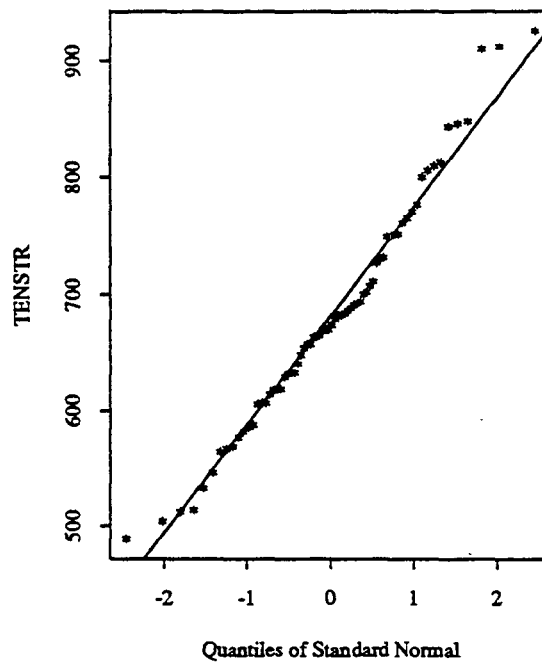
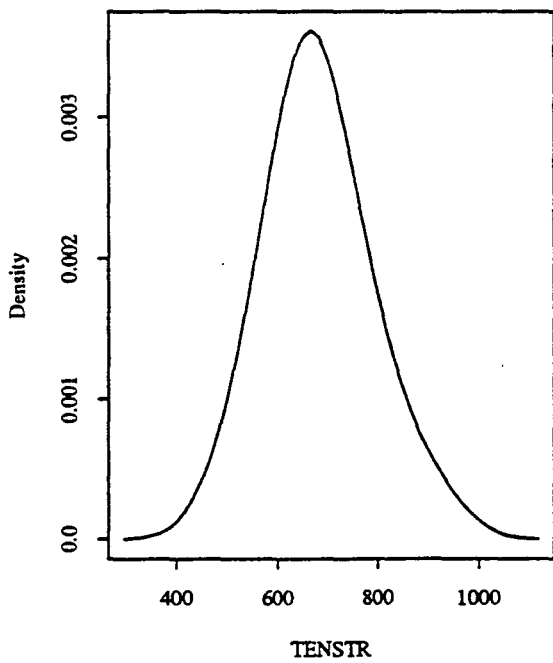
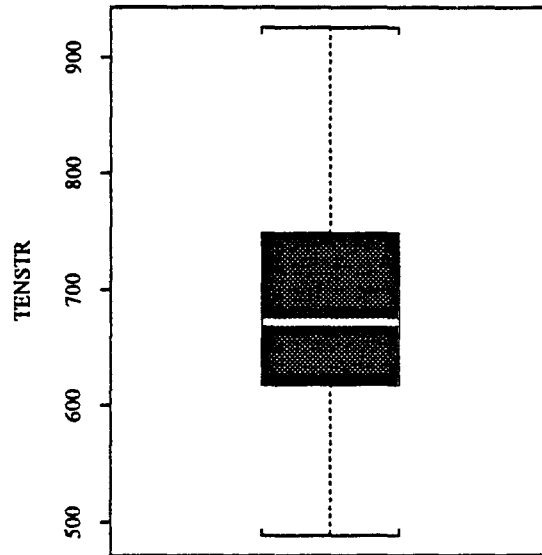
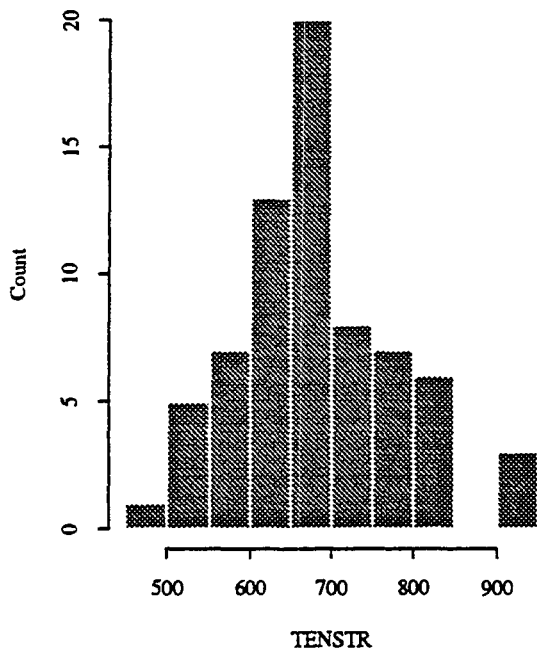


Figure 6.18 Statistical Distribution of Split Tensile Strength for GPS-5 Sections, psi