IVP Charting Examples

By

Henry Herr Office of Hydrologic Development National Weather Service

1.0 Overview

This document provides examples for use with the IVP and IVP Batch Program. It should be used in conjunction with the user's manuals in order to understand how to use the batch language and GUI to generate plots.

NOTE: Though the location ids may be real within the examples of this document, the data is manufactured for testing. These examples should not be used to draw any conclusions pertaining to the real locations.

1.1 Using This Manual

Refer to the examples herein, as needed, to understand how to generate graphics within the IVP software suite. The table provided in Section 4.0 summarizes the examples. Check the table to determine which example to examine and then go to the Section devoted to that example for more information.

2.0 Notation

The following notational conventions are used in this document:

- A GUI component, including a window, panel, text field, menu, menu item, or button, is displayed in **bold**.
- A menu item within a menu is displayed as [menu name] >> [menu item name]. For example, Actions >> Close is the Close menu item within the Actions menu.
- Terms to remember and *NOTEs* will be denoted in *italics*.
- <key> indicates a keyboard key. For example <shift> means the shift key.
- Text to be entered at a command line or in a batch file is displayed in this font.
- Directories and file names are in this font.
- A directory corresponding to an apps-defaults token is denoted \$(token).

3.0 Example Section Format

Each example section will provide the following:

- A description of the example and what the goal of the user may be in generating such a plot.
- Notes about the example.
- A listing of the batch file contents, as created by using the **IVP Batch File Creation Wizard** within the IVP.
- Screenshots of the Verification Plot Definition Manager, the Verification Group Manager (Plot Definition), and the Chosen Locations Table within the Verification Location Manager (Plot Definition).
- The produced chart image.

The batch files provided in each example section can be generalized to any locations at any RFCs by changing these sections:

- Change the "LOCATION DEFINITIONS" section appropriately for the locations used. Be sure to choose appropriate categories for analysis.
- Change the "GROUP PARAMETER DEFINITIONS" section to reflect the desired time frame. The lead time may also need to be changed if forecast lead times are longer or shorter than those in the example.
- Change the "GROUP DEFINITION(S)" section, if necessary. Specifically, the SHEF code commands and the DEF_GRP command may require changing in order to add the desired locations to the group.

4.0 Example Summary Table

#	Example Section	Description
	Number and Name	
1	Errors vs. Lead Time	Create a chart of error statistics plotted against lead time, where the lead times are 0-24, 24-48, 48-72, 72-96, and 96-120 hours . Error statistics will be plotted as a line in order to see the trend.
2	Errors and Sample Size vs. Lead Time	Create a chart of error statistics and sample size plotted against lead time. Error statistics will be plotted as a line plot along the left-hand y-axis. Sample size will be plotted as a bar plot along the right hand y-axis.
3	RMSE and Sample Size vs. Lead Time Compared Over Forecast Type Sources	Create a chart of the RMSE and sample size against lead time and compared for different forecast type sources, including persistence. Error statistics will be plotted as a line plot along the left-hand y-axis. Sample size will be plotted as a bar plot along the right hand y-axis.
4	RMSE-SS and Sample Size vs. Lead Time Compared Over Forecast Type Source	Create a chart of the RMSE skill score vs. persistence and sample size against lead time and compared for different forecast type sources. RMSE- SS will be plotted as a line plot along the left hand y-axis. Sample size will be plotted as a bar plot along the right hand y-axis.
5	RMSE-SS and Sample Size vs. Lead Time	As above, but not compared over forecast type source. The two should plots should be visibly related to each other.
6	CDF Plots of Forecasts Compared Over Observed Categories	Create a CDF special plot comparing the cumulative distribution functions of the forecast values over different ranges of observed values. This can be used to see how well the forecast discriminates between observed values.
7	PDF Plots Corresponding to CDF plots above	Create a PDF special plot that corresponds to the CDF special plots, above.
8	Quantile Plot Corresponding to CDF plots above.	Create a plot of the quantiles that corresponds to the CDF special plots, above. The quantiles will be plotted as a line plot against the left hand y-axis.
9	Categorical Statistics vs. Yearly Analysis Interval	Create a chart of the POD, FAR, and ROC Areas and the average lead time to detection against the analysis interval. The analysis period will be the months of January, February, and March over the years 1997-2002, and the analysis interval will be yearly. Statistics will be plotted as a line plot along the left hand y-axis.
10	ROC Plot Compared over Analysis Interval	Generate the ROC plots that yielded the ROC Area statistics shown in the previous example.

This example is designed to see how the forecast skill relates to lead time. The statistics displayed are error statistics, and each should tend to increase with lead time: as the lead time increases, the forecast skill decreases. However, the mean error may show no trend. This is because a consistent trend in the mean error implies bias in the forecast that becomes more significant with lead time. If the forecasts are unbiased, there should be no trend in the mean error, though the other errors should still increase.

5.1 Notes

- This example shows that it is not a good idea to plot larger statistic values along the same y-axis as smaller statistic values. In this case, the maximum error (MAXERR) is so large it makes it very difficult to see the trends present in the other three statistics.
- Note the portion of the batch file devoted to resetting the SHEF code batch commands to default values, highlighted in the next section. These commands are used to define locations (DEF_LOC) and define groups (DEF_GRP). So, if you do not reset these values to their defaults after defining the locations, you may end up accidentally restricting the locations included in a group. See the *IVP Batch Program User's Manual for Verification* for more information. In batch files generated via the **IVP Batch File Creation Wizard** of the IVP, redundancy exists for these parameters, as they are reset after defining the locations and before defining the groups.
- When computing error statistics, and when the FCST_CAT_USED and OBS_CAT_USED commands are set as highlighted, the categories play no roll in computations. So the forecast category defining boundary of 6 ft (see the **Chosen Locations Table**) has no affect on the chart.

5.2 Batch File

```
#====== LOCATION DEFINTIONS
                                                  #====== GROUP DEFINITION(S)
PE = HG
                                                 <mark>PE = <default></mark>
DUR = I
                                                  DUR = <default>
FCST_TS = FE, FF, FR
                                                 EXTREMUM = <default>
EXTREMUM = Z
                                                  FCST_TS = FE, FF, FR
OBS TYPE = RAW
                                                 RIVERRESPONSE = ALL
OBS_CAT = MIN, MAX
                                                 ACTIVE_STATUS = BOTH
FCST_CAT = MIN,6,MAX
                                                 DEF_GRP = CLKW2
DEF\_LOC = CLKW2
                                                  #====== END OF GROUP DEFINITION(S)
DUR = <default>
                                                  #====== STATISTICS PARAMETERS
                                                 QUANTILES = 0.25,0.50,0.75
EXTREMUM = <default>
PE = <default>
                                                 PDF BINS = 10
FCST_TS = <default>
                                                 ROC_PTS = 100
#===== END OF LOCATION DEFINITIONS
                                                  #====== END OF STATISTICS PARAMETERS
#====== GROUP PARAMETER DEFINITIONS
                                                  #====== GRAPHICS PARAMETER DEFINITIONS
START TIME = "2003-09-01 00:00:00"
                                                 PRIMARY STATS = RMSE, MAXERR, MAE, ME
END_TIME = "2003-10-31 23:59:59"
                                                 PRIMARY_PLOT_TYPE = LINE
                                                 SECONDARY_STATS = NONE
ANALYSIS INTERVAL = 2weeks
LEADTIME_START = 0hours
                                                  SECONDARY_PLOT_TYPE = BAR
LEADTIME_END = 5days
                                                 XAXIS_VARIABLE = LDTIME
LEADTIME_STEP = 24hours
                                                  COMP_VARIABLE = NONE
ISSUANCE_START = NONE
                                                  FCST CAT USED = ALL
                                                  OBS_CAT_USED = NON
ISSUANCE END = NONE
ISSUANCE_STEP = NONE
                                                  #====== END OF GRAPHICS PARAMETER DEFINITIONS
FCST_TS = FE, FF, FR
ACTIVE_STATUS = BOTH
                                                  GRAPH_TEMPLATE = NONE
                                                 GEN GRAPH = "example1.png,example1.dat"
RIVERRESPONSE = ALL
BREAKDOWN_BY_LID = OFF
#===== END OF GROUP PARAMETER DEFINITIONS
```

The Definition Manager. Data Dource #1	
Select Statistics and Variables	
Select Primary Statistics: Choose Stat RMSE,MAXERR,MAL	E,ME Verification Group Manager (Plot Definition): Data Source #1
Select Primary Plot Type:	Start Time: 2003-09-01 00:00:00 Fixed Rel
Select Secondary Statistics: Choose Stat	
Select Secondary Plot Type: BAR	End Time: 2003-10-31 23:59:59 Fixed Rel
Select X-Axis Variable: Leadtime Interval	Time Step: 2 + veeks
Select Comparison Variable: None	▼ Select Lead Time
Edit Statistics Parameters	Start: $0 \stackrel{*}{\vee}$ hours \checkmark End: $5 \stackrel{*}{\vee}$ days \checkmark Step: $24 \stackrel{*}{\vee}$ hours
Timing Intervals Used (based on settings above)	Select Issuance Time-of-day
Analysis Interval Used: Overall analysis period start-to-end will be u Issuance Interval Used: Overall issuance time interval start-to-end w	sed. Start: $0 \times 10^{\circ}$ NONE \checkmark End: $0 \times 10^{\circ}$ NONE \checkmark Step: $1 \times 10^{\circ}$ NONE
Lead Time Interval Used: Overall lead time interval start-to-end will be	e used.
ielect Used Categories	Fcst Type Sources:
Select Observed Category: Do Not Use Select Forecast Category: All Categories Combined	River Response: SLOW HEDIUM FAST VALL
ielect Property Template File	Active/Inactive Only. O ACTIVE O INACTIVE O BOTH
Select Graph Template:	Clear Open Location Manager
Close Load From Satch Create P	lot

Lo	cat.	ions Chosen i	Eor D	ispl	ày									Select All Sel	ect None	
a	na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type	
Y	Ν	CLKW2	HG	I.	Z	FE	FAST						MIN,6,MAX	MIN,MAX	RAW	
Y	Ν	CLKW2	HG	I .	Z	FF	FAST						MIN,6,MAX	MIN,MAX	RAW	
Y	Ν	CLKW2	HG	I.	Z	FR	FAST						MIN,6,MAX	MIN,MAX	RAW	
																-



This is a continuation of example 1. In this case, we add the sample size plotted against the right-hand yaxis. Confidence intervals are not available in this version of the IVP. So, the best way to determine how much confidence to have in a plotted statistics is to examine the number of samples used to compute those statistics.

6.1 Notes

6.2 Batch File

Differences between this batch file and that in Example 1 are highlighted.

```
#====== LOCATION DEFINTIONS
                                                 #====== GROUP DEFINITION(S)
PE = HG
                                                 PE = <default>
DUR = I
                                                 DUR = <default>
FCST TS = FE, FF, FR
                                                 EXTREMUM = <default>
                                                 FCST_TS = FE,FF,FR
EXTREMUM = Z
OBS_TYPE = RAW
                                                 RIVERRESPONSE = ALL
OBS_CAT = MIN, MAX
                                                ACTIVE_STATUS = BOTH
FCST_CAT = MIN,6,MAX
                                                DEF_GRP = CLKW2
DEF\_LOC = CLKW2
                                                 #===== END OF GROUP DEFINITION(S)
DUR = <default>
                                                 #====== STATISTICS PARAMETERS
EXTREMUM = <default>
                                                 QUANTILES = 0.25, 0.50, 0.75
PE = <default>
                                                 PDF_BINS = 10
FCST_TS = <default>
                                                 ROC_PTS = 100
#====== END OF LOCATION DEFINITIONS
                                                 #====== END OF STATISTICS PARAMETERS
#====== GROUP PARAMETER DEFINITIONS
                                                 #====== GRAPHICS PARAMETER DEFINITIONS
START TIME = "2003-09-01 00:00:00"
                                                 PRIMARY STATS = RMSE, MAXERR, MAE, ME
END_TIME = "2003-10-31 23:59:59"
                                                 PRIMARY_PLOT_TYPE = LINE
ANALYSIS_INTERVAL = 2weeks
                                                 SECONDARY_STATS = "NUM SAMPLES"
                                                 SECONDARY_PLOT_TYPE = BAR
LEADTIME START = 0hours
LEADTIME_END = 5days
                                                 XAXIS_VARIABLE = LDTIME
                                                 COMP_VARIABLE = NONE
LEADTIME_STEP = 24hours
ISSUANCE_START = NONE
                                                 FCST_CAT_USED = ALL
ISSUANCE END = NONE
                                                 OBS CAT USED = NONE
ISSUANCE_STEP = NONE
                                                 #====== END OF GRAPHICS PARAMETER DEFINITIONS
FCST_TS = FE,FF,FR
ACTIVE_STATUS = BOTH
                                                 GRAPH_TEMPLATE = NONE
RIVERRESPONSE = ALL
                                                 GEN_GRAPH = "example2.png,example2.dat"
BREAKDOWN_BY_LID = OFF
#====== END OF GROUP PARAMETER DEFINITIONS
```

Data Source #2
les
istics: Choose Stat RMSE_MAXERR_MAE_ME Verification Group Manager (Plot Definition); Data Source #1
Type: LINE 2003-09-01 00:00:00 Fixed Rel
atistics: Choose Stat NUM SAMPLES
ot Type: BAR Time: 2003-10-31 23:59:59 Fixed Rel
ble: Leadtime Interval Time Step: 2 + weeks
ariable: None Select Lead Time
istics Parameters Edit Group Parameters Start: 0 + hours V End: 5 + days V Step: 24 + hours V
ed on settings above)
eed: Overall analysis period start-to-end will be used. sed: Overall issuance time interval start-to-end will be used. Start: 0 × NONE × End: 0 × NONE × Step: 1 × NONE ×
Used: Overall lead time interval start-to-end will be used.
Fcst Type Sources:
egory: Do Not Use River Response: SLOW MEDIUM FAST VALL
egory: All Categories Combined
Active/Inactive Only: O ACTIVE O INACTIVE O BOTH
te: Select Clear Open Location Manager
Load From Batch Create Plot Close
Load From Batch Create Plot

L	ocat	ions Chosen	for D	ispla	ày									Select All Sel	ect None	
	ac na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type	
Y	N	CLKW2	HG	I.	Z	FE	FAST						MIN,6,MAX	MIN,MAX	RAW	
Y	N	CLKW2	HG	I .	Z	FF	FAST						MIN,6,MAX	MIN,MAX	RAW	
Ŷ	N	CLKW2	HG	I .	Z	FR	FAST						MIN,6,MAX	MIN,MAX	RAW	
																-



This is a continuation of example 2. In this case, we want to compare the statistics over three forecast type sources: FE, FF, and FR (persistence forecasts). However, with four statistics chosen and three type sources, there will be 12 lines produced in addition to three sample sizes. So, in this example we only examine the root-mean squared error statistic (RMSE).

7.1 Notes

- The comparison variable is reflected in the legend of the chart.
- The persistence forecast RMSE is consistently lower than the other two RMSEs. This is a sign that persistence may be outperforming the regular forecasts.

7.2 Batch File

Differences between this batch file and that in Example 2 are highlighted.

```
#====== LOCATION DEFINTIONS
                                               #====== GROUP DEFINITION(S)
                                               PE = <default>
PE = HG
DUR = T
                                               DUR = <default>
FCST_TS = FE,FF,FR
                                               EXTREMUM = <default>
EXTREMUM = Z
                                               FCST TS = FE.FF.FR
OBS_TYPE = RAW
                                               RIVERRESPONSE = ALL
OBS_CAT = MIN, MAX
                                              ACTIVE STATUS = BOTH
FCST_CAT = MIN,6,MAX
                                               DEF_GRP = CLKW2
DEF\_LOC = CLKW2
                                               #====== END OF GROUP DEFINITION(S)
DUR = <default>
                                               #====== STATISTICS PARAMETERS
                                               QUANTILES = 0.25,0.50,0.75
EXTREMUM = <default>
PE = <default>
                                               PDF_BINS = 10
FCST TS = <default>
                                               ROC PTS = 100
#====== END OF LOCATION DEFINITIONS
                                               #====== END OF STATISTICS PARAMETERS
#====== GROUP PARAMETER DEFINITIONS
                                               #====== GRAPHICS PARAMETER DEFINITIONS
START_TIME = "2003-09-01 00:00:00"
                                               PRIMARY_STATS = RMSE
END_TIME = "2003-10-31 23:59:59"
                                               PRIMARY_PLOT_TYPE = LINE
ANALYSIS_INTERVAL = 2weeks
                                               SECONDARY_STATS = "NUM SAMPLES"
                                               SECONDARY_PLOT_TYPE = BAR
LEADTIME START = 0hours
LEADTIME_END = 5days
                                               XAXIS_VARIABLE = LDTIME
LEADTIME_STEP = 24hours
                                               COMP_VARIABLE = FCST_TS
ISSUANCE_START = NONE
                                               FCST_CAT_USED = ALL
ISSUANCE_END = NONE
                                               OBS_CAT_USED = NONE
ISSUANCE_STEP = NONE
                                               #====== END OF GRAPHICS PARAMETER DEFINITIONS
FCST_TS = FE, FF, FR
ACTIVE STATUS = BOTH
                                               GRAPH TEMPLATE = NONE
RIVERRESPONSE = ALL
                                               GEN_GRAPH = "example3.png,example3.dat"
BREAKDOWN BY LID = OFF
#====== END OF GROUP PARAMETER DEFINITIONS
```

Plot Definition Manager: Data Source #3	
-Select Statistics and Variables	
Select Primary Statistics: Choose Stat RMSE	Verification Group Manager (Plot Definition): Data Source #3 Select Analysis Interval
Select Primary Plot Type:	V Start Time: 2003-09-01.00:00:00 Fixed Sel
Select Secondary Statistics: Choose Stat NUM SAMPLES	
Select Secondary Plot Type: BAR	Image: The second sec
Select X-Axis Variable: Leadtime Interval	▼ Time Step: 2 [∧] / _▼ weeks ▼
Select Comparison Variable: Forecast Type Source	Select Lead Time
Edit Statistics Parameters Edit Group Parameters	Start: $0_{\frac{n}{v}}$ hours \checkmark End: $5_{\frac{n}{v}}$ days \checkmark Step: $24_{\frac{n}{v}}$ hours \checkmark
Timing Intervals Used (based on settings above)	Select Issuance Time-of-day
Analysis Interval Used: Overall analysis period start-to-end will be used Issuance Interval Used: Overall issuance time interval start-to-end will b	L. Start: O v NONE v End: O V NONE V Step: 1 NONE v
Lead Time Interval Used: Overall lead time interval start-to-end will be us	Select Parameters
Select Used Categories	Fcst Type Sources:
Select Observed Category: Do Not Use	▼
Select Forecast Category: All Categories Combined	River Response: SLOW MEDIUM FAST ALL
-Select Property Template File	Active/Inactive Only: O ACTIVE O INACTIVE I BOTH
Select Graph Template:	Specify Verification Locations
Close Load From Batch Create Plot	Close
Chosen Locations	

Ŀ	cat.	ions Chosen i	Eor D	ispla	ày										Select All Sel	ect None	
а	: na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category		Observed Category	obs type	
Υ	Ν	CLKW2	HG	1	Z	FE	FAST						MIN,6,MAX	MIN	,MAX	RAW	
Y	Ν	CLKW2	HG	I.	Z	FF	FAST						MIN,6,MAX	MIN	,MAX	RAW	
Y	Ν	CLKW2	HG	L .	Z	FR	FAST						MIN,6,MAX	MIN	,MAX	RAW	
																	-



This is a continuation of example 3. Having seen that the persistence forecasts appear to outperform the regular forecasts, this example will display the RMSE skill score (RMSE-SS) vs. persistence (RMSESS_PER) for the different forecast type sources so that we can compare them.

8.1 Notes

- The 'FR' RMSE-SS vs. persistence is undefined, since 'FR' is the persistence forecast type source. However, the software will still see type source 'FR' as a forecast type source for which to produce a plot. Hence, the "RMSESS_PER(FR)" entry in the legend which has no corresponding data.
- Negative values for all of the skill scores confirm that persistence shows better skill than the regular forecasts relative to RMSE.
- The plot title and y-axis for this plot include the phrase "Correlation, Bias, and/or Skill". In this case, the plot is only for the skill score, so the chart properties should be adjusted to state "RMSE-SS vs. Persistence" instead via the **Chart Properties Manager** of the IVP. These changes could be saved to a template file and applied to the chart within the batch language by changing the line for GRAPH_TEMPLATE (highlighted) to specify the file location.

8.2 Batch File

Differences between this batch file and that in Example 3 are highlighted.

```
#====== LOCATION DEFINTIONS
                                               #====== GROUP DEFINITION(S)
PE = HG
                                               PE = <default>
DUR = I
                                               DUR = <default>
FCST_TS = FE, FF, FR
                                               EXTREMUM = <default>
                                               FCST_TS = FE, FF, FR
EXTREMUM = Z
OBS_TYPE = RAW
                                               RIVERRESPONSE = ALL
OBS_CAT = MIN, MAX
                                               ACTIVE STATUS = BOTH
FCST_CAT = MIN,6,MAX
                                               DEF_GRP = CLKW2
DEF\_LOC = CLKW2
                                               #====== END OF GROUP DEFINITION(S)
DUR = <default>
                                               #====== STATISTICS PARAMETERS
EXTREMUM = <default>
                                               QUANTILES = 0.25, 0.50, 0.75
PE = <default>
                                               PDF_BINS = 10
FCST TS = <default>
                                               ROC PTS = 100
#====== END OF LOCATION DEFINITIONS
                                               #====== END OF STATISTICS PARAMETERS
#====== GROUP PARAMETER DEFINITIONS
                                               #====== GRAPHICS PARAMETER DEFINITIONS
                                               PRIMARY STATS = RMSESS PER
START TIME = "2003-09-01 00:00:00"
END_TIME = "2003-10-31 23:59:59"
                                               PRIMARY_PLOT_TYPE = LINE
ANALYSIS_INTERVAL = 2weeks
                                               SECONDARY_STATS = "NUM SAMPLES"
LEADTIME START = 0hours
                                               SECONDARY_PLOT_TYPE = BAR
LEADTIME END = 5 days
                                               XAXIS_VARIABLE = LDTIME
LEADTIME_STEP = 24hours
                                               COMP VARIABLE = FCST TS
ISSUANCE_START = NONE
                                               FCST_CAT_USED = ALL
ISSUANCE END = NONE
                                               OBS CAT USED = NONE
ISSUANCE_STEP = NONE
                                               #====== END OF GRAPHICS PARAMETER DEFINITIONS
FCST_TS = FE,FF,FR
ACTIVE_STATUS = BOTH
                                                     TEMPLATE = NONE
RIVERRESPONSE = ALL
                                               GEN_GRAPH = "example4.png,example4.dat"
BREAKDOWN_BY_LID = OFF
#===== END OF GROUP PARAMETER DEFINITIONS
```

Yelot Definition Manager: Data Source #4	
Select Statistics and Variables	
Select Primary Statistics: Choose Stat MMSESS_PER	Verification Group Manager (Plot Definition): Data Source #3 Select Analysis Interval
Select Primary Plot Type:	Start Time: 2003-09-01 00:00:00 Fixed Rel
Select Secondary Statistics: Choose Stat NUM SAMPLES	
Select Secondary Plot Type: BAR	End Time: 2003-10-31 23:59:59 Fixed Rel
Select X-Axis Variable: Leadtime Interval	▼ Time Step: 2 [▲] / _▼ weeks ▼
Select Comparison Variable: Forecast Type Source	Select Lead Time
Edit Statistics Parameters [Edit Group Parameters]	Start: 0 * hours V End: 5 * days V Step: 24 * hours V
Timing Intervals Used (based on settings above)	Select Issuance Time-of-day
Analysis Interval Used: Overall analysis period start-to-end will be used. Issuance Interval Used: Overall issuance time interval start-to-end will be	start: \bigcirc_{\vee}^{\wedge} NONE \checkmark End: \bigcirc_{\vee}^{\wedge} NONE \checkmark Step: $1\frac{\wedge}{\vee}$ NONE \checkmark
Lead Time Interval Used: Overall lead time interval start-to-end will be use	Select Parameters
Select Used Categories	Fcst Type Sources:
Select Observed Category: Do Not Use Select Forecast Category: All Categories Combined	River Response: SLOW MEDIUM FAST Z ALL
Select Property Template File	Active/Inactive Only: O ACTIVE INACTIVE BOTH
Select Graph Template:	Specify Verification Locations
Close Load From Batch Create Plot	Close
Chosen Locations	

L	cat	ions Chosen	for D	ispl	ày									Select All Se	lect None	
а	c na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type	
Y	Ν	CLKW2	HG	1	Z	FE	FAST						MIN,6,MAX	MIN,MAX	RAW	
Y	Ν	CLKW2	HG	I.	Z	FF	FAST						MIN,6,MAX	MIN,MAX	RAW	
Y	N	CLKW2	HG	1	Z	FR	FAST						MIN,6,MAX	MIN,MAX	RAW	
																-

This is a continuation of example 4. This example is only used to show the relationship between the skill scores computed independently for each forecast type source, and those that would result from computing for both forecast type sources lumped together.

9.1 Notes

• The overall RMSE-SS vs. persistence is between the two scores shown in example 4. It is closer to the skill score that has a greater number of samples associated with it; that for the forecast type source FF for each lead time.

9.2 Batch File

Differences between this batch file and that in Example 4 are highlighted.

```
#====== LOCATION DEFINTIONS
                                              #====== GROUP DEFINITION(S)
PE = HG
                                              PE = <default>
DUR = T
                                              DIR = \langle default \rangle
FCST_TS = FE, FF, FR
                                              EXTREMUM = <default>
                                              FCST TS = FE, FF, FR
EXTREMUM = Z
OBS_TYPE = RAW
                                              RIVERRESPONSE = ALL
OBS CAT = MIN, MAX
                                              ACTIVE STATUS = BOTH
FCST_CAT = MIN,6,MAX
                                              DEF_GRP = CLKW2
DEF\_LOC = CLKW2
                                              #====== END OF GROUP DEFINITION(S)
DUR = <default>
                                              #====== STATISTICS PARAMETERS
                                              OUANTILES = 0.25,0.50,0.75
EXTREMUM = <default>
PE = <default>
                                              PDF_BINS = 10
FCST_TS = <default>
                                              ROC_PTS = 100
#====== END OF LOCATION DEFINITIONS
                                              #===== END OF STATISTICS PARAMETERS
                                              #====== GRAPHICS PARAMETER DEFINITIONS
#====== GROUP PARAMETER DEFINITIONS
START_TIME = "2003-09-01 00:00:00"
                                              PRIMARY_STATS = RMSESS_PER
PRIMARY_PLOT_TYPE = LINE
ANALYSIS_INTERVAL = 2weeks
                                              SECONDARY_STATS = "NUM SAMPLES"
LEADTIME START = Ohours
                                              SECONDARY PLOT TYPE = BAR
LEADTIME_END = 5days
                                              XAXIS_VARIABLE = LDTIME
LEADTIME_STEP = 24hours
                                              COMP_VARIABLE = NONE
ISSUANCE_START = NONE
                                              FCST CAT USED = ALL
ISSUANCE_END = NONE
                                              OBS_CAT_USED = NONE
ISSUANCE_STEP = NONE
                                              #====== END OF GRAPHICS PARAMETER DEFINITIONS
FCST_TS = FE, FF, FR
ACTIVE_STATUS = BOTH
                                              GRAPH_TEMPLATE = NONE
RIVERRESPONSE = ALL
                                              GEN_GRAPH = "example5.png,example5.dat"
BREAKDOWN_BY_LID = OFF
#====== END OF GROUP PARAMETER DEFINITIONS
```

▶ Plot Definition Manager: Data Source #5	
Select Statistics and Variables	
Select Primary Statistics: Choose Stat	Verification Group Manager (Plot Definition): Data Source #5
Select Primary Plot Type:	Start Time: 2003-09-01 00:00:00 Fixed Rel
Select Secondary Statistics: Choose Stat NUM SAMPLES	
Select Secondary Plot Type: BAR	End Time: 2003-10-31 23:59:59 Fixed Rel
Select X-Axis Variable: Leadtime Interval	▼ Time Step: 2 v weeks ▼
Select Comparison Variable: None	Select Lead Time
Edit Statistics Parameters Edit Group Parameters	Start: $O_{\underline{\vee}}^{\underline{\wedge}}$ hours \checkmark End: $\overline{S}_{\underline{\vee}}^{\underline{\wedge}}$ days \checkmark Step: $24\frac{\underline{\wedge}}{\underline{\vee}}$ hours \checkmark
Timing Intervals Used (based on settings above)	Select Issuance Time-of-day
Analysis Interval Used: Overall analysis period start-to-end will be used. Issuance Interval Used: Overall issuance time interval start-to-end will be	e used. Start: $O_{\underline{\vee}}^{\underline{\wedge}}$ NONE $\underline{\checkmark}$ End: $O_{\underline{\vee}}^{\underline{\wedge}}$ NONE $\underline{\checkmark}$ Step: $1_{\underline{\vee}}^{\underline{\wedge}}$ NONE $\underline{\checkmark}$
Lead Time Interval Used: Overall lead time interval start-to-end will be use	Select Parameters
Select Used Categories	Fcst Type Sources:
Select Porecast Category: Do Not Use Select Porecast Category: All Categories Combined	River Response: SLOW MEDIUM FAST ZALL
Select Property Template File	Active/Inactive Only: O ACTIVE O INACTIVE ® BOTH
Select Graph Template:	r Specify Verification Locations Open Location Manager
Close Load From Batch Ereate Plot	Close
_ Chosen Locations	

1	00	ati	ons Chosen :	for D	ispl	ày										Select All Sel	ect None	
	ac	na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category		Observed Category	obs type	
	1	N	CLKW2	HG	1	Z	FE	FAST						MIN,6,MAX	MIN,	,MAX	RAW	
	1	N	CLKW2	HG	I.	Z	FF	FAST						MIN,6,MAX	MIN;	,MAX	RAW	
	1	N	CLKW2	HG	I .	Z	FR	FAST						MIN,6,MAX	MIN,	,MAX	RAW	
																		-

This example looks at the cumulative distribution functions (CDFs) for the forecast value compared over observed categories. This is one of several tools that can be used to determine if the forecasts are distinguishing between different observed categories. The CDFs are estimated empirically from the forecast-observed pairs data.

In this specific case, precipitation is being analyzed. We want to examine how well the forecast distinguishes between zero precipitation and non-zero precipitation (defined as >0.001 inches).

10.1 Notes

- There is a noticeable difference between the two CDFs. This implies the forecast may be distinguishing fairly well between zero and non-zero precipitation events.
- The legend entries are "Cat 1" and "Cat 2", which do not state how the categories are defined. In this case, the categories are "No Precipitation" and "Precipitation". The legend component of the chart properties could be changed via the **Chart Properties Manager** of the IVP to reflect this. These changes could be saved to a template file and applied to the chart within the batch language by changing the line for GRAPH_TEMPLATE (highlighted) to specify the file location.

10.2 Batch File

```
#====== LOCATION DEFINTIONS
                                              #====== GROUP DEFINITION(S)
PE = PP
                                              PE = <default>
                                              DUR = <default>
DUR = O
FCST_TS = FW
                                              EXTREMUM = <default>
EXTREMUM = Z
                                              FCST_TS = ALL_BUT_PERSIST
OBS_TYPE = PROCESSED
                                              RIVERRESPONSE = ALL
OBS_CAT = MIN,0.001,MAX
                                              ACTIVE_STATUS = ACTIVE
                                              DEF_GRP = CRZA3,GJT,SLC
FCST_CAT = MIN, MAX
DEF_LOC = CRZA3,GJT,SLC
                                              #===== END OF GROUP DEFINITION(S)
                                              #====== STATISTICS PARAMETERS
DUR = <default>
EXTREMUM = <default>
                                              QUANTILES = 0.25,0.50,0.75
PE = <default>
                                              PDF_BINS = 10
FCST TS = <default>
                                              ROC PTS = 100
#====== END OF LOCATION DEFINITIONS
                                              #====== END OF STATISTICS PARAMETERS
#====== GROUP PARAMETER DEFINITIONS
                                              #====== GRAPHICS PARAMETER DEFINITIONS
START_TIME = "2005-01-01 00:00:00"
                                              PRIMARY STATS = CDFPLOT
END TIME = "2005-02-28 23:59:59"
                                              PRIMARY_PLOT_TYPE = LINE
ANALYSIS_INTERVAL = MONTHLY
                                              SECONDARY_STATS = NONE
                                              SECONDARY PLOT TYPE = BAR
LEADTIME_START = 0days
LEADTIME_END = 5days
                                              XAXIS_VARIABLE = NONE
LEADTIME_STEP = NONE
                                              COMP_VARIABLE = OBS_CAT
ISSUANCE_START = NONE
                                              FCST_CAT_USED = NONE
                                              OBS_CAT_USED = ALL
ISSUANCE END = NONE
ISSUANCE_STEP = NONE
                                              #====== END OF GRAPHICS PARAMETER DEFINITIONS
FCST_TS = ALL_BUT_PERSIST
ACTIVE STATUS = ACTIVE
                                               GRAPH TEMPLATE = NON
RIVERRESPONSE = ALL
                                              GEN_GRAPH = "example6.png,example6.dat"
BREAKDOWN_BY_LID = OFF
#====== END OF GROUP PARAMETER DEFINITIONS
```

Gelect Statistics and	d Variables				
Select Primary	y Statistics:	Choose Stat	CDFPLOT		Verification Group Manager (Plot Definition): Data Source #6
Select Primary	y Plot Type:	LINE		-	Start Time: 2005-01-01 00:00:00 Fixed Rel
Select Seconds	lary Statistics:	Choose Stat	4	•	
Select Seconda	lary Plot Type:	BAR		-	End Time: 2005-02-28 23:59:59 Fixed Rel
Select X-Axis	Variable:	<special plot=""></special>		-	Time Step:
Select Compari	ison Variable:	Observed Category		–	Select Lead Time
		eters Edit G	roup Parameters		
Edit	t Statistics Param				Start: 0 v days v End: 5 days v Step: 1 NONE v
Edit	t Statistics Param Jsed (based on settings a	bove)			Start: 0 days V End: 5 days V Step: 1 NONE V
Edit iming Intervals Us Analysis Inter Issuance Inter	t Statistics Param Used (based on settings a rval Used: Over rval Used: Over	bove) all analysis period star all issuance time inter	rt-to-end will be use val start-to-end will	d. be used.	Start: $0 = (days = ind; s = days = step; 1 = NONE = step; 1 = $
Edit Timing Intervals Us Analysis Inter Issuance Inter Lead Time Inte	Jsed @ased on settings a rval Used: Over rval Used: Over erval Used: Over	bove) all analysis period stau all issuance time inter- all lead time interval s	rt-to-end will be use val start-to-end will tart-to-end will be u	d. be used. ised.	Start: 0 - days • End: 5 - days • Step: 1 - NONE • Select Issuance Time - of -day Start: 0 - NONE • End: 0 - NONE • Step: 1 - NONE • Select Parameters
Edit Eming Intervals Us Analysis Inter Issuance Inter Lead Time Inte Elect Used Categor	t Statistics Param Jsed Gased on settings a rval Used: Over rval Used: Over erval Used: Over wies	bove) all analysis period sta all issuance time inter all lead time interval s	rt-to-end will be use val start-to-end will tart-to-end will be t	d. be used. ised.	Start: 0 - days Ime - of -day Select Issuance Time - of -day Start: 0 - none Foot NONE Start: 0 - none Foot None Edit Ime - of -day Start: 0 - none Foot None Edit Ime - of -day Start: 0 - none Start: 0 - none Foot None Edit List
Edit Imming Intervals Us Analysis Inter Issuance Inter Lead Time Inte elect Used Categor Select Observe Select Forecas	t Statistics Param (sed based on settings a urval Used: Over urval Used: Over erval Used: Over mries ed Category: A st Category: D	bove) all analysis period star all issuance time interval s all lead time interval s il Cetegories Combined	rt-to-end will be use val start-to-end will tart-to-end will be t	d. be used. used.	Start: 0 - days Ime - of - day Select Issuance Time - of - day Start: 0 - none Fost NONE Fost Type Sources: ALL_BUT_PERSIST Edit List River Response: SLOW MEDIUM FAST ALL
Edit Siming Intervals Us Analysis Inter Issuance Inter Lead Time Inte Select Used Categor Select Observe Select Forecas	t Statistics Param Jsed Øased on settings a rval Used: Over erval Used: Over mies ed Category: at Category: mplate File	bove) all analysis period star all issuance time interval all lead time interval s il Categories Combined o Not Use	rt-to-end will be use val start-to-end will tart-to-end will be t	d. be used. ised.	Start: 0 days Image: None with the start of th
Edit Sming Intervals US Analysis Inter Issuance Inter Lead Time Inter Getet Used Categor Select Observe Select Forecas Gelect Property Ten Select Graph 1	Ised based on settings a real Used: Over erval Used: Over erval Used: Over mries ed Category: mplate File Template:	bove) all analysis period star all issuance time interval s all lead time interval s il Categories Combined o Not Use	rt-to-end will be use val start-to-end will tart-to-end will be u Select CI	d. be used. ised.	Start: 0 days V End: 5 days V Step: 1 NONE V Select Issuance Time of day Start: 0 NONE End: 0 NONE Step: 1 NONE V Select Parameters Fost Type Sources: ALL_BUT_PERSIST Fost Type Sources: ALL_BUT_PERSIST River Response: SLOW MEDIUM FAST V ALL Active/Inactive Only: ACTIVE INACTIVE BOTH Specify Verification Locations Open Location Manager

Locations Chosen for Display Select All Select Non															
ac n	a location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type	
í N	CRZA3	PP	Q	Z	F₩	MEDIUM	-			-		MIN,MAX	MIN,0.001,MAX	PROC	-
í N	GJT	PP	Q	Z	F₩	MEDIUM	-			-		MIN,MAX	MIN,0.001,MAX	PROC	
í N	SLC	PP	Q	Z	F₩	MEDIUM	-			-		MIN,MAX	MIN,0.001,MAX	PROC	
															•

This is a continuation of example 6. This example looks at the probability density functions (PDFs) for the forecast value compared over observed categories. This is another tool that can be used to determine if the forecasts are distinguishing between different observed categories well. The PDFs are, theoretically, mathematically related to the CDFs. However, within the IVP, the PDFs are estimated independently using a histogram approach. The points in the estimate are connected via lines.

11.1 Notes

- There is a noticeable difference between the two PDFs. This further implies the forecast may be distinguishing fairly well between zero and non-zero precipitation events.
- By default, 10 "bins" are used to estimate the points of the histogram. If it is decided that more bins should be used, that change can be made in the system settings file of the IVP. See Appendix A in the *IVP User's Manual*. To see the changes, IVP would need to be restarted or the plot regenerated via the IVP Batch Program. Currently, there is no way to change the number of bins via the IVP GUI, itself.

11.2 Batch File

Differences between this batch file and that in Example 6 are highlighted.

```
#====== LOCATION DEFINTIONS
                                               #====== GROUP DEFINITION(S)
PE = PP
                                               PE = <default>
DUR = Q
                                               DUR = <default>
FCST_TS = FW
                                               EXTREMUM = \langle default \rangle
EXTREMUM = Z
                                              FCST_TS = ALL_BUT_PERSIST
                                              RIVERRESPONSE = ALL
OBS_TYPE = PROCESSED
OBS_CAT = MIN,0.001,MAX
                                              ACTIVE STATUS = ACTIVE
FCST CAT = MIN, MAX
                                              DEF_GRP = CRZA3,GJT,SLC
DEF_LOC = CRZA3,GJT,SLC
                                               #===== END OF GROUP DEFINITION(S)
DUR = <default>
                                               #====== STATISTICS PARAMETERS
EXTREMUM = <default>
                                               QUANTILES = 0.25,0.50,0.75
PE = <default>
                                               PDF BINS = 10
                                               ROC_PTS = 100
FCST TS = <default>
#===== END OF LOCATION DEFINITIONS
                                               #===== END OF STATISTICS PARAMETERS
#====== GROUP PARAMETER DEFINITIONS
                                               #====== GRAPHICS PARAMETER DEFINITIONS
START_TIME = "2005-01-01 00:00:00"
                                               PRIMARY_STATS = PDFPLOT
END_TIME = "2005-02-28 23:59:59"
                                               PRIMARY_PLOT_TYPE = LINE
ANALYSIS_INTERVAL = MONTHLY
                                              SECONDARY_STATS = NONE
LEADTIME_START = 0days
                                               SECONDARY_PLOT_TYPE = BAR
LEADTIME_END = 5days
                                              XAXIS VARIABLE = NONE
LEADTIME_STEP = NONE
                                               COMP_VARIABLE = OBS_CAT
ISSUANCE START = NONE
                                               FCST CAT USED = NONE
ISSUANCE END = NONE
                                               OBS_CAT_USED = ALL
ISSUANCE_STEP = NONE
                                               #====== END OF GRAPHICS PARAMETER DEFINITIONS
FCST_TS = ALL_BUT_PERSIST
ACTIVE_STATUS = ACTIVE
                                               GRAPH_TEMPLATE = NONE
RIVERRESPONSE = ALL
                                               GEN_GRAPH = "example7.png,example7.dat"
BREAKDOWN_BY_LID = OFF
#===== END OF GROUP PARAMETER DEFINITIONS
```

Plot Definition Manager: Data Source #7	
Select Statistics and Variables	
Select Primary Statistics: Choose Stat	Verification Group Manager (Plot Definition): Data Source #6 Selert Analysis Interval
Select Primary Plot Type:	v Start Time: 2005-01-01 00:00:00 Fixed Rel
Select Secondary Statistics: Choose Stat	
Select Secondary Plot Type:	End Time: 2005-02-28 23:39:59 Fixed Rel
Select X-Axis Variable:	Time Step:
Observed Category	Select Lead Time
Edit Statistics Parameters Edit Group Parameters	Start: $0 \times 10^{\circ}$ days V End: $5 \times 10^{\circ}$ days V Step: $1 \times 10^{\circ}$ NONE V
liming Intervals Used (based on settings above)	Select Issuance Time-of-day
Analysis Interval Used: Overall analysis period start-to-end will be used.	
Issuance Interval Used: Overall issuance time interval start-to-end will be	e used
Lead Time Interval Head, Ormall load time interval don't to and will be use	Select Parameters
and the interval occu. Overall lead the interval start-to-end will be dee	
Select Used Categories	Fost Type Sources:
Select Observed Category: All Categories Combined	
Select Forecast Category: Do Not Use	River Response: SLOW MEDIUM FAST ALL
elect Property Template File	Active/Inactive Only: ACTIVE INACTIVE BOTH
Select (Tes	Specify Verification Locations
Select Graph Template:	Open Location Manager
Close Load From Batch Create Plot	Close
-Chosen Locations	
Locations Chosen for Display	Select All Select None

Lo	Locations Chosen for Display Select M1 Select Mon															
a	na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type	
Y	N	CRZA3	PP	Q	Z	F₩	MEDIUM						MIN,MAX	MIN,0.001,MAX	PROC	
Y	Ν	GJT	PP	Q	Z	F₩	MEDIUM						MIN,MAX	MIN,0.001,MAX	PROC	
Y	Ν	SLC	PP	Q	Z	F₩	MEDIUM						MIN,MAX	MIN,0.001,MAX	PROC	
																-

This is a continuation of example 6. This example computes the minimum, 25% non-exceedance quantile, 50% quantile, 75% quantile, and the maximum for each of the cumulative distributions in example 6. The observed category is displayed along the x-axis instead of as a comparison variable in order to make the plot easier to read.

12.1 Notes

- The quantiles here do correctly correspond to the CDFs shown in the chart of example 6.
- Note the use of the special command token "@+". This token will never be used in an IVP generated batch file. It was added to the batch file in this example so that the line widths are not too long, and to show how a line continuation is done using "@+" in the IVP's batch language. See Section 12.0 of the *IVP Batch Program User's Manual for Verification* for more details.

12.2 Batch File

Differences between this batch file and that in Example 6 are highlighted.

```
#====== LOCATION DEFINTIONS
                                               PE = <default>
PE = PP
                                              DUR = <default>
DUR = O
                                               EXTREMUM = <default>
FCST_TS = FW
                                               FCST_TS = ALL_BUT_PERSIST
EXTREMUM = 7
                                              RIVERRESPONSE = ALL
OBS_TYPE = PROCESSED
                                              ACTIVE_STATUS = ACTIVE
OBS_CAT = MIN,0.001,MAX
                                               DEF_GRP = CRZA3,GJT,SLC
FCST_CAT = MIN, MAX
                                               #====== END OF GROUP DEFINITION(S)
DEF_LOC = CRZA3,GJT,SLC
                                               #====== STATISTICS PARAMETERS
                                               QUANTILES = 0.25,0.50,0.75
DUR = <default>
EXTREMUM = <default>
                                               PDF BINS = 10
PE = <default>
                                               ROC_PTS = 100
FCST TS = <default>
                                               #====== END OF STATISTICS PARAMETERS
#====== END OF LOCATION DEFINITIONS
                                               #====== GRAPHICS PARAMETER DEFINITIONS
#====== GROUP PARAMETER DEFINITIONS
                                               PRIMARY_STATS = "MINIMUM,QUAN 0.25,MEDIAN,"
START_TIME = "2005-01-01 00:00:00"
                                               @+ = "QUAN 0.75,MAXIMUM"
END TIME = "2005-02-28 23:59:59"
                                               PRIMARY_PLOT_TYPE = SCATTER
ANALYSIS_INTERVAL = MONTHLY
                                               SECONDARY_STATS = "NUM SAMPLES"
                                               SECONDARY_PLOT_TYPE = BAR
LEADTIME_START = 0days
LEADTIME_END = 5days
                                               XAXIS_VARIABLE = OBS_CAT
                                               COMP_VARIABLE = NONE
LEADTIME_STEP = NONE
ISSUANCE_START = NONE
                                               FCST CAT USED = NONE
                                               OBS_CAT_USED = ALL
ISSUANCE END = NONE
ISSUANCE_STEP = NONE
                                               #====== END OF GRAPHICS PARAMETER DEFINITIONS
FCST_TS = ALL_BUT_PERSIST
ACTIVE STATUS = ACTIVE
                                               GRAPH TEMPLATE = NONE
RIVERRESPONSE = ALL
                                               GEN_GRAPH = "example8.png,example8.dat"
BREAKDOWN_BY_LID = OFF
#====== END OF GROUP PARAMETER DEFINITIONS
```

#====== GROUP DEFINITION(S)

<u> </u>	Plot Definition Manager: Data Source #	8	_ D X
-	elect Statistics and Variables		
	Select Primary Statistics:	Choose Stat	0.25,MED
	Select Primary Plot Type:	SCATTER	-
	Select Secondary Statistics:	Choose Stat NUM SAMPLES	
	Select Secondary Plot Type:	BAR	-
	Select X-Axis Variable:	Observed Category	-
	select comparisón Variable:	None	
	Edit Statistics Para	Edit Group Parameters	
Γŕ	ming Intervals Used (based on settings	above)	
	Analysis Interval Used: Ove Issuance Interval Used: Ove	rall analysis period start-to-end will be us rall issuance time interval start-to-end wil	ed. 1 be used.
	Lead Time Interval Used: Ove	rall lead time interval start-to-end will be	used.
	elect Used Categories		
	Select Observed Category:	All Categories Combined	
	elect Property Template File		
	Select Graph Template:	Select C	lear
	[]ose	Load From Batch Create Pl	ot

L	Locations Chosen for Display Select All Select None															
	ac na	a location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type	
Y	N	CRZA3	PP	Q	Z	F₩	MEDIUM		-		-		MIN,MAX	MIN,0.001,MAX	PROC	
Y	N	GJT	PP	Q	Z	F₩	MEDIUM						MIN,MAX	MIN,0.001,MAX	PROC	
Y	N	SLC	PP	Q	Z	F₩	MEDIUM						MIN,MAX	MIN,0.001,MAX	PROC	
IΓ																
																-

IVP Charting Examples

This example is designed to show how the skill of the forecast relative to categorical statistics probably of detection (POD), false alarm ratio (HFAR), and ROC plot area (ROCAREA) has changed over the years. Hopefully over time our forecasts will improve: the POD will approach 1, the HFAR will approach 0, and the ROC area will approach 1.

13.1 Notes

- As with previous examples, the chart properties should be changed for this plot. Specifically, the secondary y-axis title should be changed to be "ROC Area". The primary y-axis title can be left the same.
- The ROC Area computed for the years 1999 and 2000 is 0. This is likely a product of insufficient data for those years, since it is indicative of no observed values exceeding the observed threshold; in this case, 20 ft. See Appendix B.7 of the *IVP User's Manual*. This was verified by examining the pairs used in the computations via the **Verification Pairs Data Viewer** of the IVP. The x-axis (observed value axis) was changed so that its lower bound was 20 ft. Examination of the pairs showed that all pairs exceeding that threshold were in 1997 and 1998. None were in 1999 or 2000.
- There is also no ROC Area computed for the first category ("Cat 1", in the legend). This is because that categories lower bound is "MIN" or -INFINITY. This is not a valid threshold for compute the ROC plot, so no plot is produced and the ROC Area is set to -999.0.

13.2 Batch File

```
#====== LOCATION DEFINITONS
                                               #====== GROUP DEFINITION(S)
PE = HG
                                               PE = <default>
DUR = I
                                               DUR = <default>
FCST_TS = FF
                                               EXTREMUM = <default>
EXTREMUM = Z
                                               FCST_TS = FF
OBS TYPE = RAW
                                               RIVERRESPONSE = ALL
OBS_CAT = MIN, 20.0, MAX
                                               ACTIVE_STATUS = ACTIVE
FCST_CAT = MIN, 20.0, MAX
                                               DEF GRP = ELRP1
DEF_LOC = ELRP1
                                               #====== END OF GROUP DEFINITION(S)
DUR = <default>
                                               #====== STATISTICS PARAMETERS
EXTREMUM = <default>
                                               OUANTILES = 0.25, 0.50, 0.75
PE = <default>
                                               PDF BINS = 10
FCST_TS = <default>
                                               ROC_PTS = 100
#====== END OF LOCATION DEFINITIONS
                                               #====== END OF STATISTICS PARAMETERS
#====== GROUP PARAMETER DEFINITIONS
                                               #====== GRAPHICS PARAMETER DEFINITIONS
START_TIME = 1997 - 01 - 01
                                               PRIMARY_STATS = POD, HFAR
END_TIME = 2000 - 03 - 31
                                               PRIMARY_PLOT_TYPE = LINE
ANALYSIS_INTERVAL = YEARLY
                                               SECONDARY_STATS = ROCAREA
LEADTIME_START = 0days
                                               SECONDARY_PLOT_TYPE = BAR
LEADTIME END = 3days
                                               XAXIS VARIABLE = ANAL INT
LEADTIME_STEP = 1days
                                               COMP_VARIABLE = OBS_CAT
ISSUANCE START = NONE
                                               FCST CAT USED = NONE
ISSUANCE_END = NONE
                                               OBS_CAT_USED = ALL
ISSUANCE STEP = NONE
                                               #====== END OF GRAPHICS PARAMETER DEFINITIONS
FCST_TS = FF
ACTIVE_STATUS = ACTIVE
                                               GRAPH_TEMPLATE = NONE
RIVERRESPONSE = ALL
                                               GEN_GRAPH = "example9.png,example9.dat"
BREAKDOWN_BY_LID = OFF
#===== END OF GROUP PARAMETER DEFINITIONS
```

-last Castinias and Hamishias			
elect Statistics and Variables			
Select Primary Statistics:	Choose Stat POD,HFAR	Þ	Verification Group Manager (Plot Definition): Data Source ≠11 Select Analysis Interval
Select Primary Plot Type:	LINE	•	Start Time 1997-01-01 Fixed Re
elect Secondary Statistics:	Choose Stat ROCAREA	•	
elect Secondary Plot Type:	BAR	•	End Time: 2000-03-31
elect X-Axis Variable:	Analysis Interval		Time Step: 0 + YEARLY VEARLY
elect Comparison Variable:	Observed Category	-	- Select Lead Time
Edit Statistics Par	rameters Edit Group Parameters		
			Start: 0 days V End: 3 days V Step: 1 days
ning Intervals Used (based on setting	s above)		Select Issuance Time-of-day
nalysis Interval Used: Ot ssuance Interval Used: Ot	erall analysis period start-to-end will be use verall issuance time interval start-to-end will	d. be used.	Start: $0 \xrightarrow{*}{\vee}$ NONE \checkmark End: $0 \xrightarrow{*}{\vee}$ NONE \checkmark Step: $1 \xrightarrow{*}{\vee}$ NONE
ead Time Interval Used: Ov	zerall lead time interval start-to-end will be u	ised.	Select Parameters
lect liced Categories			FF
ACCC OFCU CUCCEDIALS			East Type Sources Edit Lis
			Fost Type Sources:
elect Observed Category:	All Categories Combined	-	Fcst Type Sources: Edit Lis River Response: SLOW
elect Observed Category: elect Forecast Category:	All Categories Combined	•	Fcst Type Sources: Edit Lis River Response: SLOW
elect Observed Category: elect Forecast Category: dect Property Template File	All Categories Combined Do Not Use		Fcst Type Sources: Fcst Type Sources: Edit Lis River Response: SLOW MEDIUM FAST Image: All Lis Active/Inactive Only: ACTIVE INACTIVE BOTH
elect Observed Category: elect Forecast Category: det Property Template File	All Categories Combined		Fcst Type Sources:
elect Observed Category: elect Porecast Category: dect Property Template File elect Graph Template:	All Categories Combined Do Not Use Select C1	ear	Fest Type Sources: Fest Type Sources: Elit Lia River Response: SLOW MEDIUM FAST ALL Active/Inactive Only: Active / Inactive Both Specify Verification Locations Open Location Manager Active / Inactive Both Copen Location Manager Active / Inactive Both Both Both Both Both Active / Inactive Both Both Both Both Both Both Both

I	ocat	tions Chosen	for D	Select X11 Sel	ect None											
ΙF	ac n	a location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type	Т
1	΄ Ν	ELRP1	HG	1	Z	FE	FAST	-999.0					MIN,20.0,MAX	MIN,20.0,MAX	RAW	4
١	΄ Ν	ELRP1	HG	I.	Z	FF	FAST	-999.0					MIN,20.0,MAX	MIN,20.0,MAX	RAW	Т
١	΄ Ν	ELRP1	HG	I.	Z	FR	FAST	-999.0					MIN,20.0,MAX	MIN,20.0,MAX	RAW	1
ΙΓ																
															_	4
																1

This is a continuation of example 9. This example shows how to generate ROC plots corresponding to the ROC area computations of example 9.

14.1 Notes

- The OBS_CAT_USED command is being used to define the observed threshold for the computation of the ROC plots. The threshold is always the lower bound of the category specified by either OBS_CAT_USED or FCST_CAT_USED. In this case, the threshold is 20 ft. This will make the plots correspond to the "Cat 2" plots in example 9.
- This, combined with example 9, imply that the forecasts perform well relative to the two categories, below 20 ft and above 20 ft.

14.2 Batch File

Differences between this batch file and that in Example 9 are highlighted.

```
#====== LOCATION DEFINTIONS
                                                #====== GROUP DEFINITION(S)
PE = HG
                                               PE = <default>
DUR = I
                                               DUR = \langle default \rangle
FCST_TS = FF
                                               EXTREMUM = <default>
EXTREMUM = Z
                                               FCST TS = FF
OBS TYPE = RAW
                                               RIVERRESPONSE = ALL
OBS_CAT = MIN, 20.0, MAX
                                               ACTIVE_STATUS = ACTIVE
FCST_CAT = MIN, 20.0, MAX
                                               DEF_GRP = ELRP1
DEF_LOC = ELRP1
                                               #====== END OF GROUP DEFINITION(S)
DUR = <default>
                                               #====== STATISTICS PARAMETERS
EXTREMUM = <default>
                                               QUANTILES = 0.25,0.50,0.75
PE = <default>
                                               PDF_BINS = 10
                                               ROC_PTS = 100
FCST TS = <default>
#====== END OF LOCATION DEFINITIONS
                                               #====== END OF STATISTICS PARAMETERS
#====== GROUP PARAMETER DEFINITIONS
                                               #====== GRAPHICS PARAMETER DEFINITIONS
START_TIME = 1997-01-01
                                                PRIMARY_STATS = ROCPLOT
END TIME = 2000 - 03 - 31
                                               PRIMARY_PLOT_TYPE = LINE
ANALYSIS_INTERVAL = YEARLY
                                                SECONDARY_STATS = NON
                                               SECONDARY_PLOT_TYPE = BAR
LEADTIME_START = 0days
LEADTIME_END = 3days
                                                XAXIS_VARIABLE = NONE
LEADTIME STEP = 1days
                                                COMP VARIABLE = ANAL INT
ISSUANCE_START = NONE
                                               FCST_CAT_USED = NONE
ISSUANCE_END = NONE
                                                OBS_CAT_USED = CAT2
                                                #====== END OF GRAPHICS PARAMETER DEFINITIONS
ISSUANCE_STEP = NONE
FCST_TS = FF
ACTIVE STATUS = ACTIVE
                                               GRAPH_TEMPLATE = NONE
RIVERRESPONSE = ALL
                                                GEN_GRAPH = "example10.png,example10.dat"
BREAKDOWN BY LID = OFF
#===== END OF GROUP PARAMETER DEFINITIONS
```

Plot Definition Manager: Data Source #13	
Select Statistics and Variables	
Select Primary Statistics: Choose Stat	Verification Group Manager (Plot Definition): Data Source #13 Select Analysis Interval
Select Primary Plot Type:	Start Time 1997-01-01
Select Secondary Statistics: Choose Stat	
Select Secondary Plot Type: BAR	End Time: 2000-03-31 Fixed Rel
Select X-Axis Variable: <special plot=""></special>	Time Step: 0 YEARLY
Select Comparison Variable: Analysis Interval	Select Lead Time
Edit Statistics Parameters Edit Group Parameters	Start: 0 + days - End: 3 + days - Step: 1 + days
iming Intervals Used (based on settings above)	Select Issuance Time-of-day
Analysis Interval Used: Overall analysis period start-to-end will be used. Issuance Interval Used: Overall issuance time interval start-to-end will be	e used. Start: $0 \times 10^{\circ}$ NONE \checkmark End: $0 \times 10^{\circ}$ NONE \checkmark Step: $1 \times 10^{\circ}$ NONE
Lead Time Interval Used: Overall lead time interval start-to-end will be use	Select Parameters
elect Used Categories	Fcst Type Sources:
Select OBS Integnold Based on Observed Category Category 2	River Response: SLOW MEDIUM FAST ALL
elect Property Template File	Active/Inactive Only. Active/Inactive Only. Active Only.
Select Graph Template:	Specify Verification Locations
Close Load From Batch Create Plot	
Chosen Locations	

Loc	at:	ions Chosen :	for D	ispl	ày									Select X11 Sel	ect None	
ac	na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type	
Y	N	ELRP1	HG	1	Z	FE	FAST	-999.0					MIN,20.0,MAX	MIN,20.0,MAX	RAW	
Y	N	ELRP1	HG	I I	Z	FF	FAST	-999.0					MIN,20.0,MAX	MIN,20.0,MAX	RAW	
Y	N	ELRP1	HG	I I	Z	FR	FAST	-999.0					MIN,20.0,MAX	MIN,20.0,MAX	RAW	
																-

