

Tumor Response Visualization in Clinical Trial Oncology Studies

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Oncology Clinical Trials

Analysis Challenges

- Creating deterministic/consistent endpoints for tumor response
- Data capture and evaluation of solid tumor lesions
- Appropriate Analysis and Visualization of early efficacy
 - Complex trial designs and small sample sizes

Response Evaluation Criteria in Solid Tumors (RECIST)

International guidelines originally developed by World Health Organization (WHO)

- RECIST Overview
 - Identify Target Lesion Response
 - Max 5 lesions (generally >10mm in size), Max 2 lesions per organ
 - Sum of the longest diameters (uni-dimensional)
 - short axis consideration for nodal tumors.
 - Disease Response Identification
 - Complete Response (CR): All target lesions disappear/shrink.
 - Partial Response (PR): At least **30% decrease** in the sum of target lesions WRT baseline.
 - Progressive Disease (PD): At least **20% increase** in tumor burden response WRT minimum lesion sum on study (nadir).
 - Stable Disease (SD): Change in tumor burden response fails to qualify for either PR or PD.
- RECIST Endpoints common for regulatory approval by both FDA and EMA
 - Objective Response Rate (CR + PR) for early efficacy

Detecting Early Efficacy Signals

Waterfall Plots

- Ordered Quantitative Best Response

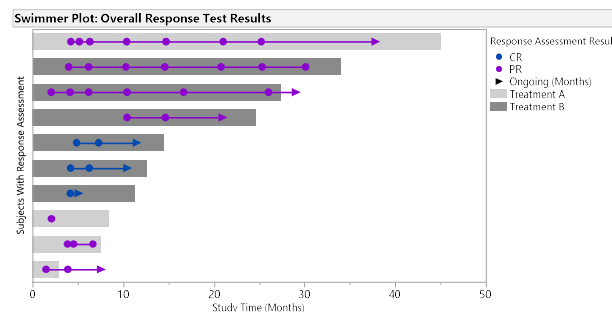
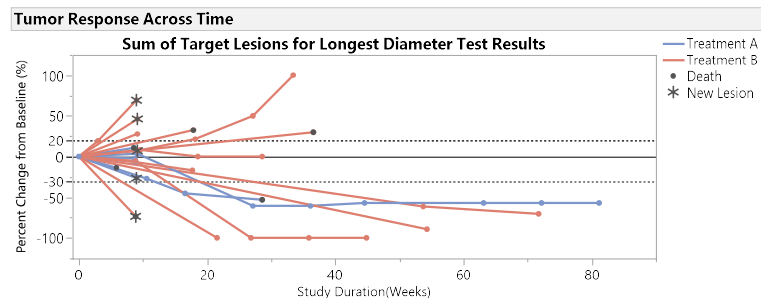
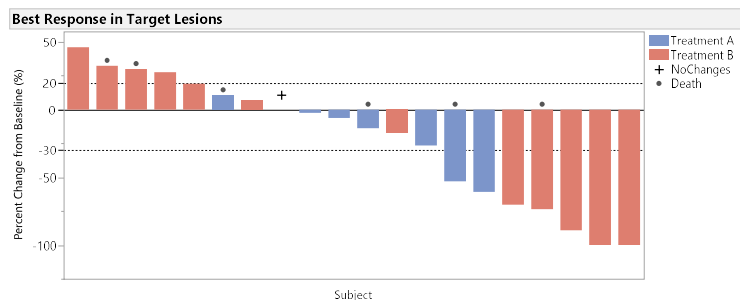
Time Trend Plots

- Tumor Burden response across time
- Nicknames: Line, Spider, Spaghetti Plots

Swimmer Plots

- Qualitative response and duration

Effective Tumor Response Visualization



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JMP Clinical Solution

Solid tumor oncology clinical review

Review Builder - Oncology Template - JMP Clinical

Report Navigator | Review Subject Filter

Search for subject IDs. Use * for wildcard. Use , to separate

Subject Filter

Clear Reset Help

Inverse

Study Identifier (1)
JMPCOnco

25 ≤ Age ≤ 84

Sex (2)
F M

Race (2)
BLACK/AFRICAN-AMERICAN | WHITE/CAUCASIAN (54)

Study Site Identifier (8)
001 (16)
002 (6)
003 (18)
004 (9)
005 (11)
006 (7)
008 (2)
009 (8)

AND OR

Subject List

JMPCO11-001
JMPCO11-002
JMPCO11-003
JMPCO11-004
JMPCO11-005
JMPCO11-006
JMPCO11-007
JMPCO11-008
JMPCO11-009
JMPCO11-010
JMPCO11-011
JMPCO11-012
JMPCO11-013
JMPCO11-014
JMPCO11-015
JMPCO11-016
JMPCO12-001
JMPCO12-002
JMPCO12-003
JMPCO12-004
JMPCO12-005
JMPCO12-006
JMPCO13-001
JMPCO13-002
JMPCO13-003
JMPCO13-004
JMPCO13-005
JMPCO13-006
JMPCO13-007
JMPCO13-008
JMPCO13-009
JMPCO13-010
JMPCO13-011

Demographics | Disposition | Tumor Response | **Disease Response** | irRC Disease Response | Progression Free Survival

Disease Response

Disease Response Assessment (RECIST 1.1)
Displaying results for 10 (out of 50) subjects who had at least one Overall Response test assessment recorded as one of the following values: CR, PR.

Swimmer Plot: Overall Response Test Results

Subjects With Response Assessment

Treatment B

Treatment A

Response Assessment Results

- CR
- PR
- ▶ Ongoing (Months)
- Treatment A
- Treatment B

Study Time (Months)

Best Response Summary: Overall Response Test Results

	Description of Planned Arm					
	Treatment A (N = 17)	Treatment B (N = 33)	Total Subjects (N = 50)			
Objective Response Rate (ORR)	Count	%	Count	%	Total Count	Total %
CR + PR	4	23.5%	6	18.2%	10	20.0%

Oncology Example

Creating Oncology Plots with Graph Builder

Benefits and Challenges

- Benefits
 - Interactive (Drag-Drop) with *Rich* library of Element options
 - Directly tied to your data
 - Doesn't require extensive programming or derivation to create visualization
 - Dynamically filter data to explore and find insight/patterns
 - Highly customizable
- Challenges
 - Interactive (Drag-Drop) with *Overwhelming* library of Element options
 - Directly tied to your data
 - May require unique data structures unsuited to other analyses
 - Some customization and element/variable control only available via JSL

Key Graph Builder Highlights

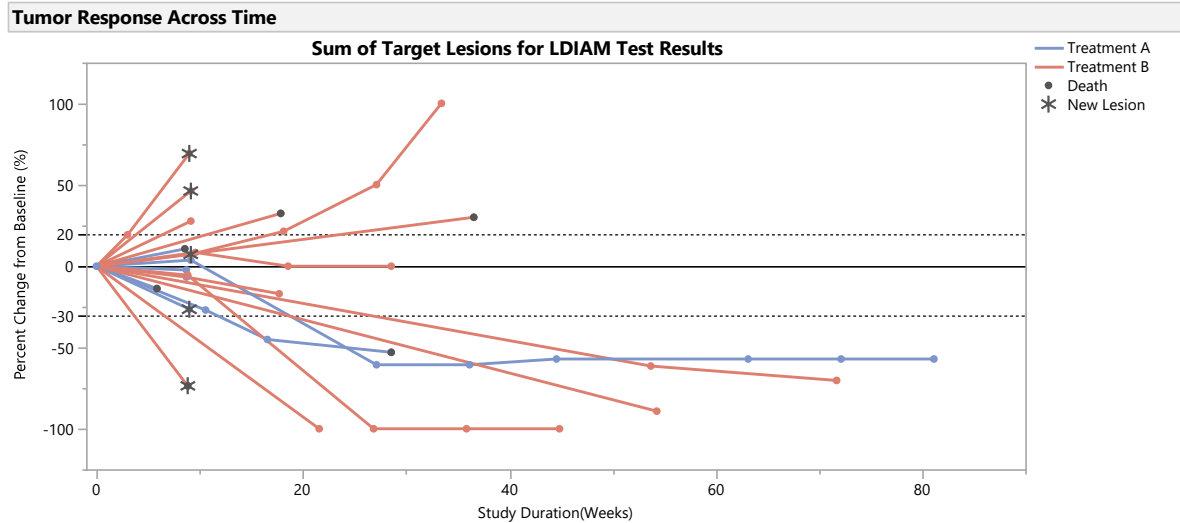
- Multiple Elements with Variable Control
- Legend Settings Control
 - Especially when using multiple elements/colors
- Data Formatting for Element Behavior
- Data Filtering Impacts
- Multiple Frame Control
- When to use JSL

Tumor Response Visualization in JMP/JMP Clinical

Demo



Tumor Burden Spider Plot



```

Variables(
  X( :Name( "Study Duration(Weeks)" ),
  X( :Death, Position( 1 ) ),
  X( :New Lesion, Position( 1 ) ),
  Y( :Name( "Percent Change from Baseline (%)" ),
  Overlay( :Unique Subject Identifier ),
  Color( "Description of Planned Arm" )
),
Elements(
  Line( X( 1 ), Y, Legend( 1 ), Summary Statistic( "Min" ) ),
  Points( X( 1 ), Y, Overlay( 0 ), Legend( 2 ) ),
  Points( X( 2 ), X( 3 ), Y, Overlay( 0 ), Color( 0 ), Legend( 3 ) )
),

```

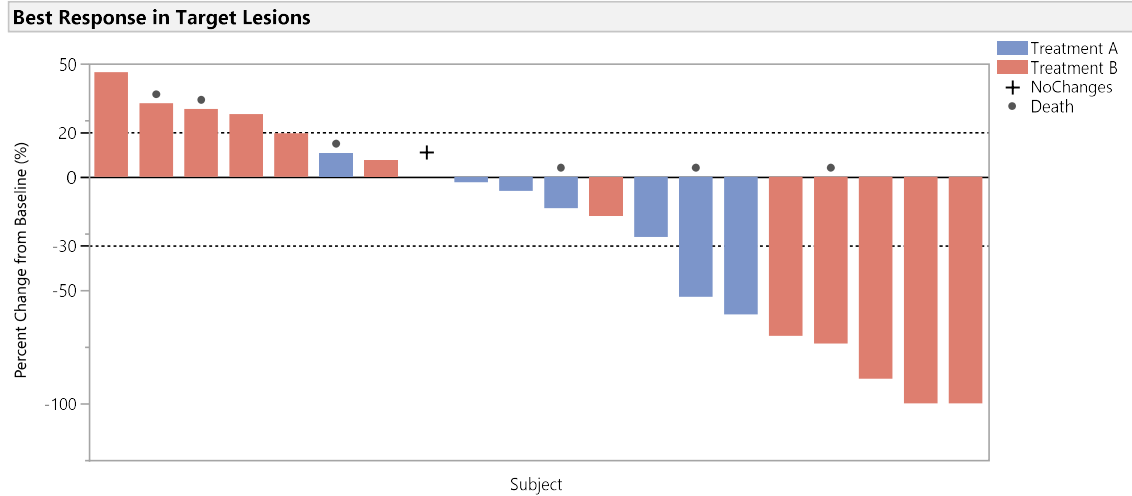
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JMP Implementation

- 3 Elements
 - Line, Points, Points
- 6 Variables
 - 3 in X Role (point annotation)
 - 1 Y Role for all elements
 - Overlay
 - Color
- Element/Variable Control
 - Overlay for Subject Lines (new in 14)
 - Color
 - X Variables
- Legend Control
 - Item ID() to control Legend Items
 - Set Marker Size and Marker
 - Legend Index to Hide Elements



Best Response Waterfall Plot



```

Variables(
  X( :Unique Subject Identifier, Order By( :Name( "Percent Change from Baseline (%)" ), Descending, Order Statistic( "Min" ) ) ),
  Y( :Name( "Percent Change from Baseline (%)" ) ),
  Y( :NoChanges, Position( 1 ) ),
  Y( :_DSDECOD_, Position( 1 ) ),
  Color( :Description of Planned Arm )
),
Elements(
  Bar( X, Y( 1 ), Legend( 7 ), Bar Style( "Stacked" ), Summary Statistic( "Min" ) ),
  Points( X, Y( 2 ), Y( 3 ), Color( 0 ), Legend( 6 ) )
),
Where( :Best == 1 ),

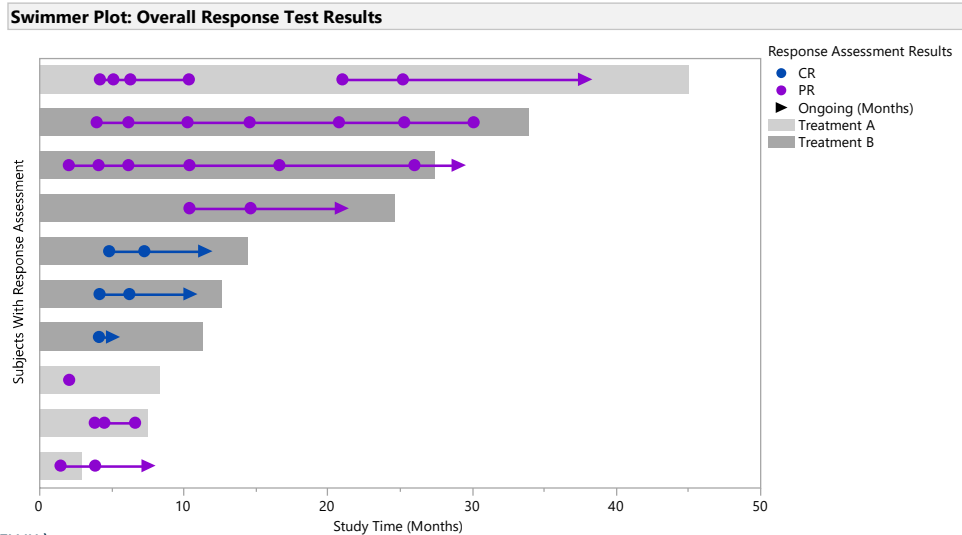
```

JMP Implementation

- 2 Elements
 - Bar, Points
- 5 Variables
 - 3 Y Roles (Bar Height & Point annotation)
 - 1 X ordered by Y
 - Color (Bar)
- Element/Variable Control
 - Color
 - Y Variables (Bar vs. Point)
- Legend Control
 - Item ID() for Marker Control
- Where Statement
 - JSL to LINK Spider Plot to Waterfall Plot
 - BEST column value in data



Swimmer Plot: Duration of Positive Tumor Response



```

X(:RFWK),
X(:RSWK, Position( 1 )),
X(:Response Assessment, Position( 1 )),
X(:Name( "Ongoing (Months)" ), Position( 1 )),
Y(:Unique Subject Identifier, Order By( :RFWK, Ascending, Order Statistic( "Mean" )),
Overlay( :Unique Subject Identifier ),
Color( :Name( "Character Result/Finding in Std Format" )),
Color( :Description of Planned Arm )
),
Elements(
Bar( X( 1 ), Y, Overlay( 0 ), Color( 2 ), Legend( 2 ), Summary Statistic( "Max" )),
Line( X( 2 ), Y, Color( 1 ), Legend( 5 ), Row order( 1 ), Missing Values( "No Connection" )),
Points( X( 3 ), X( 4 ), Y, Overlay( 0 ), Color( 1 ), Legend( 4 ), Jitter( "None" ) )
),

```

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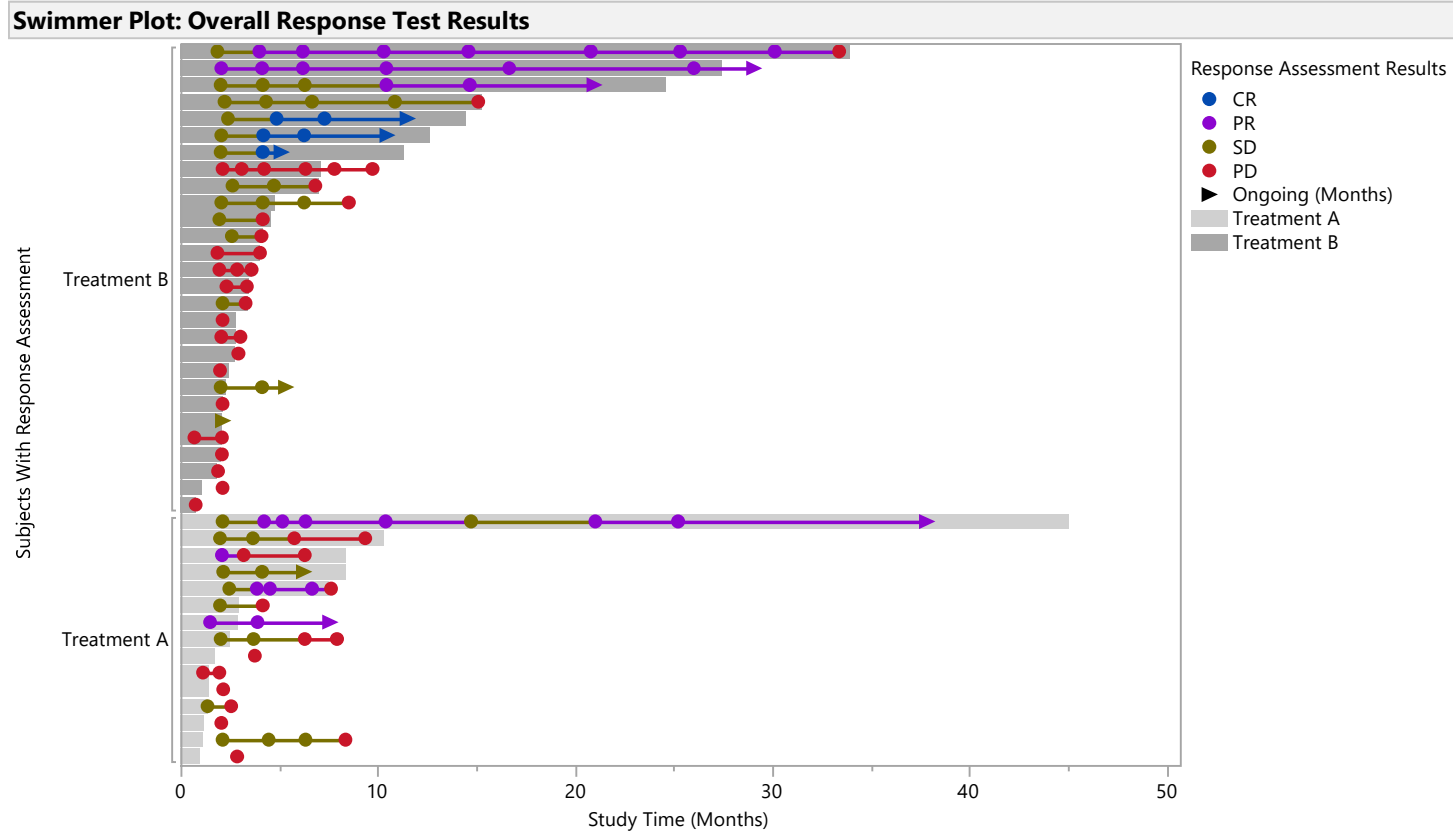
JMP Implementation

- 3 Elements
 - Bar, Line, Points
- 8 Variables
 - 4 X Roles
 - 2 Color Roles
- Element/Variable Control
 - Overlay for Lines on Subject Lanes*
- Legend Control
 - Item ID() for Color/Marker Control
 - Legend ID to Hide Elements
- Data Formatting
 - Record duplication
 - Support Line/Point Response Color Changes
 - Support "Breaks" in Response



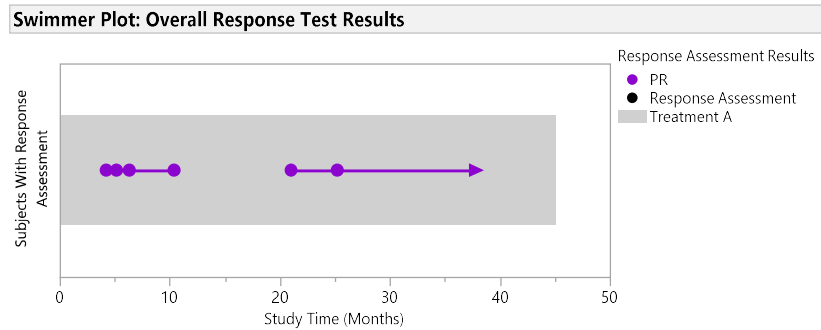
Swimmer Plot

Visualizing Response, Stable Disease and Progressive Disease



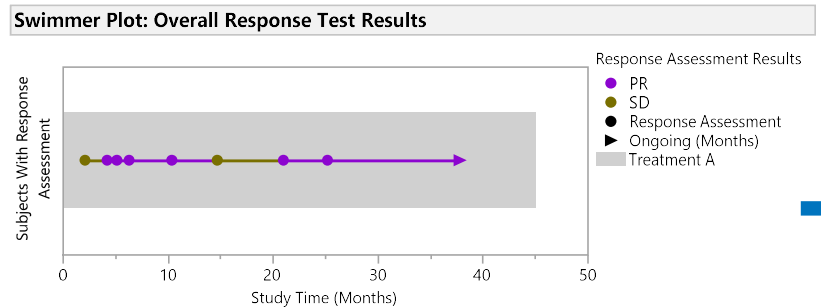
Swimmer Plot Data Formatting

- Supporting Line Breaks



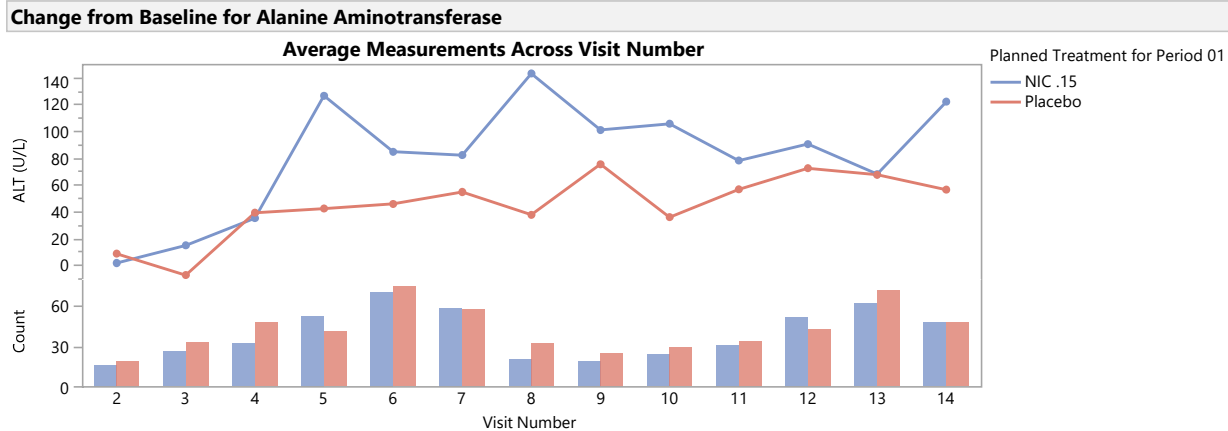
Unique Subject Identifier	Character Result/...	Visit Number	Visit Name	RSWK	
1	JMPCO13-007	PR	7	CYCLE 7	4.233333333
2	JMPCO13-007	PR	.	.	5.166666667
3	JMPCO13-007	PR	7.1	UNSCHEDULED	5.166666667
4	JMPCO13-007	PR	.	.	6.333333333
5	JMPCO13-007	PR	10	CYCLE 10	6.333333333
6	JMPCO13-007	PR	.	.	10.4
7	JMPCO13-007	PR	16	CYCLE 16	.
8	JMPCO13-007	PR	.	.	.
9	JMPCO13-007	PR	31	CYCLE 31	21.03333333
10	JMPCO13-007	PR	.	.	25.23333333
11	JMPCO13-007	PR	37	CYCLE 37	25.23333333
12	JMPCO13-007	PR	.	.	37.83333333
13	JMPCO13-007	PR	55	CYCLE 55	.

- Supporting Color Changes



Unique Subject Identifier	Character Result/...	Visit Number	Visit Name	RSWK	
1	JMPCO13-007	SD	4	CYCLE 4	2.133333333
2	JMPCO13-007	SD	.	.	4.233333333
3	JMPCO13-007	PR	7	CYCLE 7	4.233333333
4	JMPCO13-007	PR	.	.	5.166666667
5	JMPCO13-007	PR	7.1	UNSCHEDULED	5.166666667
6	JMPCO13-007	PR	.	.	6.333333333
7	JMPCO13-007	PR	10	CYCLE 10	6.333333333
8	JMPCO13-007	PR	.	.	10.4
9	JMPCO13-007	PR	16	CYCLE 16	10.4
10	JMPCO13-007	PR	.	.	14.73333333
11	JMPCO13-007	SD	22	CYCLE 22	14.73333333
12	JMPCO13-007	SD	.	.	21.03333333
13	JMPCO13-007	PR	31	CYCLE 31	21.03333333
14	JMPCO13-007	PR	.	.	25.23333333
15	JMPCO13-007	PR	37	CYCLE 37	25.23333333
16	JMPCO13-007	PR	.	.	37.83333333
17	JMPCO13-007	PR	55	CYCLE 55	.

Summary Time Trends With Count Plots



JMP Implementation

- Multiple Frames Elements
 - Use of Relative Sizes Option
- Elements for Each Frame
 - Line & Points
 - Bar
- Summary Statistic Control
 - Y Value
 - Show average in line trend
 - Count of records for bar chart

- Incorporate subject counts into visualization of treatment summaries

```

Variables(
  X( :Visit Number ), Y( :ALT ), Y( :ALT ), Overlay( :Planned Treatment for Period 01 )
),
Relative Sizes( "Y", [2 1] ),
Elements( Position( 1, 1 ),
  Line( X, Y, Legend( 1 ) ),
  Points( X, Y, Legend( 2 ), Summary Statistic( "Mean" ) )
),
Elements( Position( 1, 2 ),
  Bar( X, Y, Legend( 19 ), Summary Statistic( "N" ) )
),
Where( !Is Missing( :ALT ) )
    
```

Summary

- JMP Implementation of Oncology Visualization
 - Highly customizable options in Graph Builder
 - Interactive and Dynamically Filter
 - Avoid lengthy graphical programming
 - Possibly at cost of careful data formatting considerations

Thank You!

Questions?

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