

Interim Survival Analysis Across 3 Platforms

Venita DePuy, PhD
Bowden Analytics

What is Interim Analysis?

- ▶ Pre-planned (and pre-specified!) looks at the data at specific intervals
- ▶ If data is overwhelmingly good (or bad), it may warrant stopping the trial
- ▶ Many different approaches: O'Brien-Fleming, Pocock, Lan-DeMets approaches to those, and many others
- ▶ We will use Lan-DeMets approach to O'B-F

Overview

- ▶ **Sample Size Calculations**
- ▶ **Interim Analysis Design**
- ▶ **Performing the Interim Analysis**
 - Analysis (PROC LIFETEST, PHREG)
 - Interim Analysis
- ▶ **Can be performed in SAS, EAST, PASS, and others**

Comparison of Packages

▶ SAS

- Calculate sample size & boundaries for interim: Proc Seqdesign
- Survival calculation: Proc Lifetest or PHReg
- Interim analysis in Proc Seqtest (bring in data from Seqdesign and Lifetest/PHReg)

▶ EAST

- Point & click interfaces
- Many options for sample size & boundary calculations
- Perform survival analysis
- Enter parameter estimates (δ) calculated earlier to perform interim analysis
- Many output options (graphs)

▶ PASS

- Point & click interface for sample size & boundaries
- Separate software required for interim analysis

An Example Trial

- ▶ Treatment Arms A (active) and B (control)
 - Randomized 1:1
- ▶ Primary Endpoint is Increase in Lab X Value past a predetermined threshold
 - Expect median time to hit threshold to be 20 days in treatment A and 30 days in treatment B
- ▶ Slow enrollment: 50 subjects every 6 months
- ▶ 6 month duration of study (censored after)
- ▶ Testing whether duration differs between treatments
 - $H_0: \theta = 0$ against $H_a: \theta \neq 0$ where $\theta = -\ln(\lambda)$, and λ is the hazard ratio

Sample Size using Proc Power

```
proc power;  
  twosamplesurvival test=logrank alpha=0.05  
    groupmedsurvtimes=(20 30)  
    npergroup=.  
    accrualtime=730  
    followuptime=180  
    power=.80;  
run;
```

6 month
f/up = 180
days

Computed N Per Group	
Actual Power	N Per Group
0.804	99

Sample Size with Proc SeqDesign

```
proc seqdesign    boundaryscale=StdZ;
```

Default is
standardized
Z scale

```
OverallStudy: Design nstages=1  
                alpha=0.05 beta=.2;
```

1 stage = no
interim
analysis

```
Samplesize model=TWOSAMPLESURVIVAL  
  (medsurvtime=20 nullmedsurvtime=30  
   ref= hazard accrual=uniform  
   acctime=730 foltime=180);  
run;
```

Sample Size with Proc SeqDesign

Sample Size Summary	
Test	Two-Sample Survival
Null Hazard Rate	0.023105
Hazard Rate (Group A)	0.034657
Hazard Rate (Group B)	0.023105
Hazard Ratio	$-\theta_1 = 1.5$
log(Hazard Ratio)	0.405465
Reference Hazards	Alt Ref
Accrual	Uniform

Sample Size Summary	
Accrual Rate	0.261731
Accrual Time	730
Follow-up Time	180
Total Time	910
Max Number of Events	190.968
Max Sample Size	191.0639
Expected Sample Size (Null Ref)	191.0639
Expected Sample Size (Alt Ref)	191.0639

Boundary Information (Standardized Z Scale) Null Reference = 0							
Stage	Information Level			Alternative Reference		Boundary Values	
	Proportion	Actual	Events	Lower	Upper	Lower	Upper
						Alpha	Alpha
1	1.0000	47.74201	190.968	-2.80159	2.80159	-1.95996	1.95996

vs. 198
from Proc
Power

I_0 is based on
 α, β, θ_1

$\pm \theta_1 \sqrt{I_0}$

± 1.96

Designing the Interim Analysis

```
proc seqdesign boundaryscale=stdz  
    ALTREF = -0.40547;
```

$$\begin{aligned}\theta_1 &= -\ln(30/20) \\ &= -0.40547\end{aligned}$$

```
TwoSidedOBF_Lan: design nstages=2  
    alpha=0.05    beta=.2  
    method=errfuncOBF    info=cum(85 198)  
    stop=both (betaboundary=nonbinding);
```

Analyses at 85 &
198 subjects

```
ods output Boundary=BoundZ;  
run;
```

Interim Analysis Design Output

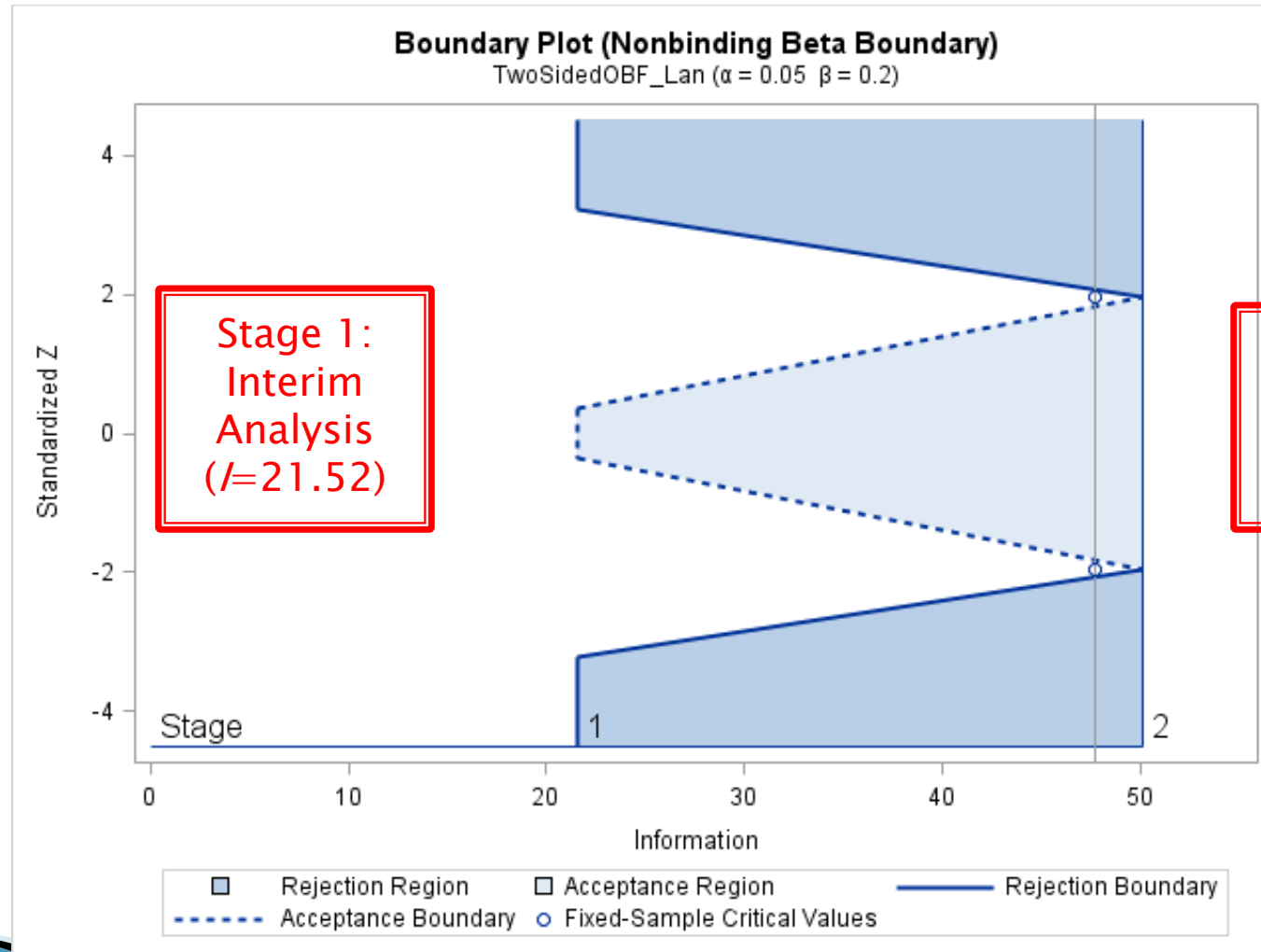
Design Information (select rows)	
Boundary Scale	Standardized Z
Early Stop	Accept (Nonbinding)/ Reject Null
Method	Error Spending
Number of Stages	2
Alpha (Binding Beta Boundary)	0.04712
Alpha (Nonbinding Beta Boundary)	0.05
Max Information (Percent of Fixed Sample)	104.9799
Max Information	50.1183
Null Ref ASN (Percent of Fixed Sample)	88.39329
Alt Ref ASN (Percent of Fixed Sample)	96.62317

Stage	Boundary Information (Standardized Z Scale)							
	Nonbinding Beta Boundary, Null Reference = 0							
	Information Level		Alternative Reference		Boundary Values			
	Proportion	Actual	Lower	Upper	Alpha	Beta	Beta	Alpha
1	0.4293	21.5154	-1.8808	1.8808	-3.2276	-0.3526	0.3526	3.2276
2	1.0000	50.118	-2.8705	2.8705	-1.9636	-1.9636	1.9636	1.9636

Very stringent
at interim

Almost 1.96

Interim Analysis Design Output



Performing Survival Analysis

```
proc lifetest data=samp;  
  time mTIME*CENSOR(1) ;  
  test TRT;  
  ods output logunichisq=PARMS;  
run;
```

PARMS dataset:

Randomly generated data

N=85

Exponential distributions
20% censored at mean 14d
Subjects on study censored
at 180d

Results

38 in Trt A (1), 47 in Trt B (2)
5 & 8 censored respectively
Mean time in uncensored=22.4, 28.5d

Variable	Statistic	StdErr	ChiSq	ProbChiSq
trt	4.6995	4.0794	1.3271	0.2493

Performing Interim Analysis

- ▶ Proc Seqdesign with output in correct units
 - Score statistic for Proc Lifetest
 - MLE for Proc PHReg
- ▶ Perform survival analysis (Lifetest or PHReg)
- ▶ Proc Seqtest to combine results from both

Proc Seqdesign & Manipulation

```
proc seqdesign boundaryscale=SCORE altref = -0.40547;  
  TwoSidedOBF_Lan: design nstages=2  alpha=0.05  
    beta=.2 method=errfuncOBF  info=cum(85 198)  
    stop=both (betaboundary=nonbinding);  
ods output Boundary=Bounds;  
run;
```

Proc Lifetest Parameter Output Manipulation

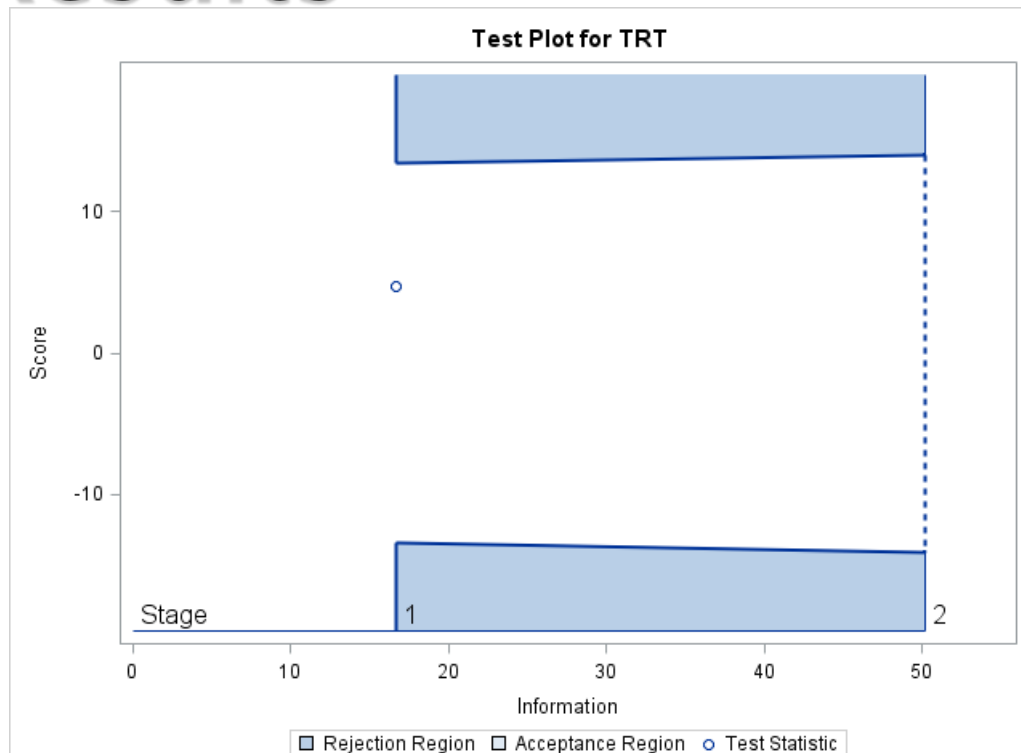
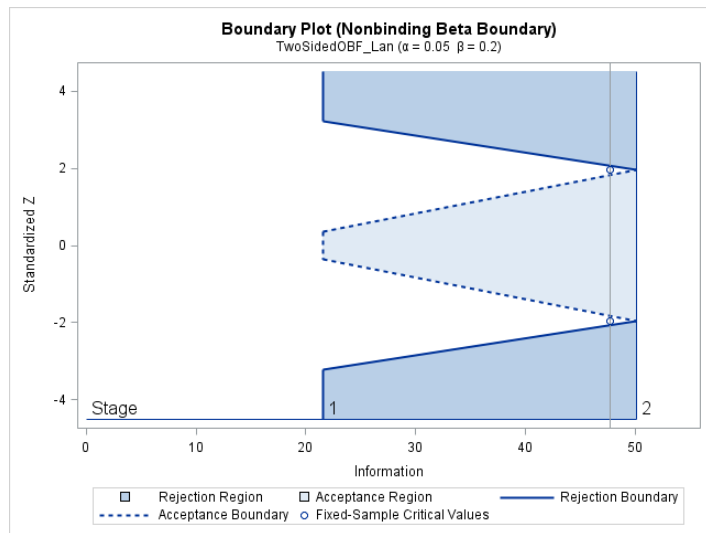
```
data PARMSs (keep = VARIABLE _SCALE_ _STAGE_ STDERR ESTIMATE);  
  set PARMS (rename=(Statistic=Estimate));  
  if VARIABLE='TRT';  
    _SCALE_='Score';  
    _STAGE_=1;  
run;
```

If using Proc PHReg...
Limit to PARAMETER='TRT',
no rename statement,
SCALE='MLE'

Proc Seqtest

```
proc seqtest boundary=BoundS  
  parms (Testvar=trt) = parmsS  
  infoadj=prop  
  boundaryscale=Score;  
ods output test=testS;  
run;
```

Proc Seqtest Results



Test Information (Score Scale)
Null Reference = 0

-Stage-	Information Level		Alternative Reference		Boundary Values				Test TRT	
	Proportion	Actual	Lower	Upper	Alpha	Beta	Beta	Alpha	Estimate	Action
1	0.3320	16.6411	-6.74747	6.74747	-13.4636	.	.	13.46356	4.69946	Continue
2	1.0000	50.1183	-20.3215	20.3215	-14.0831	-14.0831	14.0831	14.0831	.	

Proc Seqdesign vs Seqtest Results

Stage	Boundary Information (Score Scale) Nonbinding Beta Boundary, Null Reference = 0							
	Information Level		Alternative Reference		Boundary Values			
					Lower		Upper	
	Proportion	Actual	Lower	Upper	Alpha	Beta	Beta	Alpha
1	0.4293	21.51543	-8.72386	8.72386	-14.97129	-1.63544	1.63544	14.97129
2	1.0000	50.1183	-20.32147	20.32147	-13.90099	-13.90099	13.90099	13.90099

Planned

Actual

Stage	Test Information (Score Scale) Null Reference = 0									
	Information Level		Alternative Reference		Boundary Values				Test TRT	
					Lower		Upper			
	Proportion	Actual	Lower	Upper	Alpha	Beta	Beta	Alpha	Estimate	Action
1	0.3320	16.6411	-6.74747	6.74747	-13.4636	.	.	13.46356	4.69946	Continue
2	1.0000	50.1183	-20.3215	20.3215	-14.0831	-14.0831	14.0831	14.0831	.	.

Sample Size Calculations in EAST

Welcome to East 6

☐ Open Tutorial

☒ Design New Trial

End Point

- ☐ Continuous
- ☐ Discrete
- ☒ Survival
- ☐ General
- ☐ Count Data

Procedure

- ☒ Two Samples

Type: Logrank Test Given Accrual Duration and Study Duration [SU-2S-LRSD]

☐ Open Existing Workbook

More Workbooks...

☒ Show this Dialog Box at Startup

OK Cancel

Sample Size Calculations in EAST

Design: Survival Endpoint: Two-Sample Test - Parallel Design - Logrank Given Accrual Duration and

Design Type: **Superiority** Number of Looks: **1**

Design Parameters Accrual/Dropout Info

Test Type: **2-Sided**

of Hazard Pieces: **1**

Input Method: **Median Survival Times**

Type I Error (α): **0.05**

Power: **0.8**

☐ Hazard Ratio (Optional)

Alternative

☐ Hazard Ratio (λ_t / λ_c)

1.5

☐ Ratio of Medians (m_t / m_c)

0.667

Sample Size (n): **Computed**

No. of Events: **Computed**

Allocation Ratio:
(n_t / n_c) **1**

Period #	Med. Surv. Time (Control)	Med. Surv. Time (Treatment: Alt.)
1	30.000	20.000

Design Parameters Accrual/Dropout Info

Subjects are followed: **Until End of Study**

Accrual Info

Accrual Duration: **730** Study Duration: **910**

of Accrual Periods: **1**

Period #	By Time	Cum. % Accrued
1	730.000	100.000

Piecewise Dropout Information

of Pieces: **0** Input Method: **Hazard Rates**

Period #	Starting at Time	Hazard Rate (Control)	Hazard Rate (Treatment)

Sample Size Results from EAST

	Des 1
Mnemonic	SU-2S-LRSD
Test Parameters	
Design Type	Superiority
No. of Looks	1
Test Type	2-Sided
Specified α	0.05
Power	0.8
Model Parameters	
Allocation Ratio (nt/nc)	1
Hazard Ratio (Alt.)	1.5
Var (Log HR)	Null
Accrual & Dropout Parameters	
Subjects are Followed	Until End of Study
No. of Accrual Periods	1
No. of Dropout Pieces	0
Sample Size	
Maximum	192
Expected Under H0	192
Expected Under H1	192
Events	
Maximum	191
Expected Under H0	191
Expected Under H1	191
Study Duration	
Maximum	910
Expected Under H0	835.258
Expected Under H1	814.914
Accrual Duration	
Maximum	730
Expected Under H0	730
Expected Under H1	730

Interim Analysis Design in EAST

Design Type: Superiority Number of Looks: 2

Design Parameters

Boundary Info

Accrual/Dropout Info

Test Type: 2-Sided

of Hazard Pieces: 1

Input Method: Median Survival Times

Type I Error (α): 0.05

Power: Computed ☒

Sample Size (n): 198 ☐

No. of Events: Computed ☒

☐ Hazard Ratio (Optional)

☐ Hazard Ratio (λ_t/λ_c)

☐ Ratio of Medians (m_t/m_c)

Alternative

1.5

0.667

Period #	Med. Surv. Time (Control)	Med. Surv. Time (Treatment: Alt.)
1	30.000	20.000

Design Parameters

Boundary Info

Accrual/Dropout Info

Efficacy

Boundary Family: Spending Functions

Spending Function: Lan-DeMets

Parameter: OF

Type I Error (α): 0.05

Futility

Boundary Family: Spending Functions

Spending Function: Lan-DeMets

Parameter: OF

Type II Error (β): 0.196

☒ Non-Binding
☐ Binding

Spacing of Looks

☐ Equal

☒ Unequal

Boundary Scale:

Z Scale



Look #	Info. Fraction	Stop for Efficacy	Stop for Futility	Cum. α Spent	Efficacy Boundary		Cum. β Spent	Futility Boundary	
					Upper	Lower		Upper	Lower
1	0.4293	☒	☒	0.001	3.219	-3.219	0.024	0.168	-0.168
2	1	☒	☒	0.050	1.964	-1.964	0.196	1.964	-1.964

Interim Analysis Calculations in EAST

Design: Survival Endpoint: Two-Sample Test - Parallel Design - Logrank Given Accrual Duration and Study Duration

Test Parameters	
Design ID	Des1
Design Type	Superiority
Number of Looks	2
Test Type	2-Sided
Specified α	0.05
Attained α	0.049
Power	0.802
Model Parameters	
$HR = \lambda_t / \lambda_c$	
Under H0	1
Under H1	1.5
Ratio of Medians:	0.667
Var (Log HR)	Null
Allocation Ratio (n_t/n_c)	1
Boundary Parameters	
Spacing of Looks	Unequal
Efficacy Boundary	LD (OF)
Futility Boundary	LD (OF) (NB)
Accrual/Dropout Parameters	
Accrual Duration	730
Max Study Duration	910
Dropout	No

Fixed Follow-up Design: All subjects are followed for maximum 180 time units, or until drop out or failure.

Sample Size Information

	Control Arm	Treatment Arm	Total
Sample Size (n)			
Maximum	99	99	198
Expected H1	93.363	93.363	186.726
Expected H0	92.311	92.311	184.623
Events (s)			
Maximum	97	99	196
Expected H1	96.278	98.329	183.849
Expected H0	97.204	97.204	181.268
Maximum Information (I):49			

Accrual and Study Duration

	Accrual Duration	Study Duration
Maximum	730	842.072
Expected H1	688.435	788.348
Expected H0	680.679	837.003

Stopping Boundaries: Look by Look

Look #	Info. Fraction (s/s_max)	Events (s)	Cumulative α Spent	Cumulative β Spent	Boundaries			
					Efficacy Z		Futility Z	
					Upper	Lower	Upper	Lower
1	0.429	84	0.001	0.024	3.231	-3.231	0.164	-0.164
2	1	196	0.05	0.198	1.964	-1.964	1.964	-1.964

Events, Sample Size, Pipeline and Analysis Times: Look by Look (Under H0)

Look #	Info. Fraction (s/s_max)	Sample Size (n)	Events (s)	Pipeline (n-s)	Analysis Time	Boundary Crossing Probability (Incremental)		
						Efficacy		Futility
						Upper	Lower	
1	0.429	97	84	13	355.037	6.175E-4	6.175E-4	0.13
2	1	198	196	2	910	0.024	0.024	0.821

Performing Analysis in EAST

Data Set: interim_analysis.cyx

Main Advanced

Trial Type: Superiority Response Variable: mTIME Frequency Variable:

Population ID: TRT

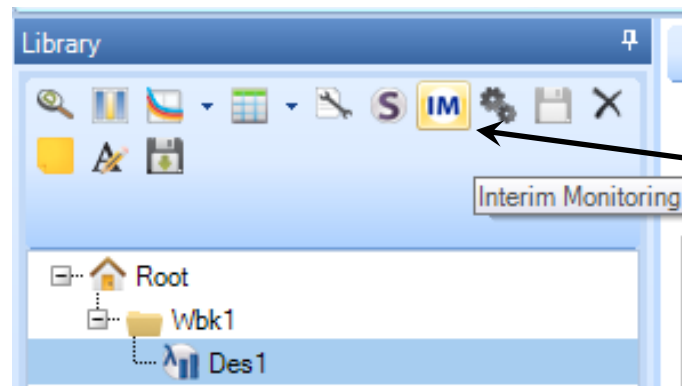
Control: 2

Treatment: 1

Sensor Indicator: CENSOR

Censored: 1

Complete: 0



Performing Interim Analysis in EAST

The screenshot shows a 'Test Statistic Calculator' dialog box with a blue title bar and a red close button. The dialog is titled 'Editing Look #1'. It contains a checkbox 'Set Current Look as Last' which is unchecked. Below this, there are three input fields: 'Cumulative Events:' with the value '72', 'Estimate of δ :' with the value '0.27532', and 'Standard Error of Estimate of δ :' with the value '0.23973'. The 'Estimate of δ :' field has a formula $\delta = \ln(\lambda_t / \lambda_c)$ displayed below it. At the bottom, there is an 'Output' section with a 'Test Statistic:' field showing the value '1.148'. At the very bottom of the dialog are three buttons: 'Recalc', 'OK' (which is highlighted with a blue border), and 'Cancel'.

Test Statistic Calculator

Editing Look #1

☐ Set Current Look as Last

Cumulative Events: 72

Input for Survival end point

Estimate of δ : 0.27532
 $\delta = \ln(\lambda_t / \lambda_c)$

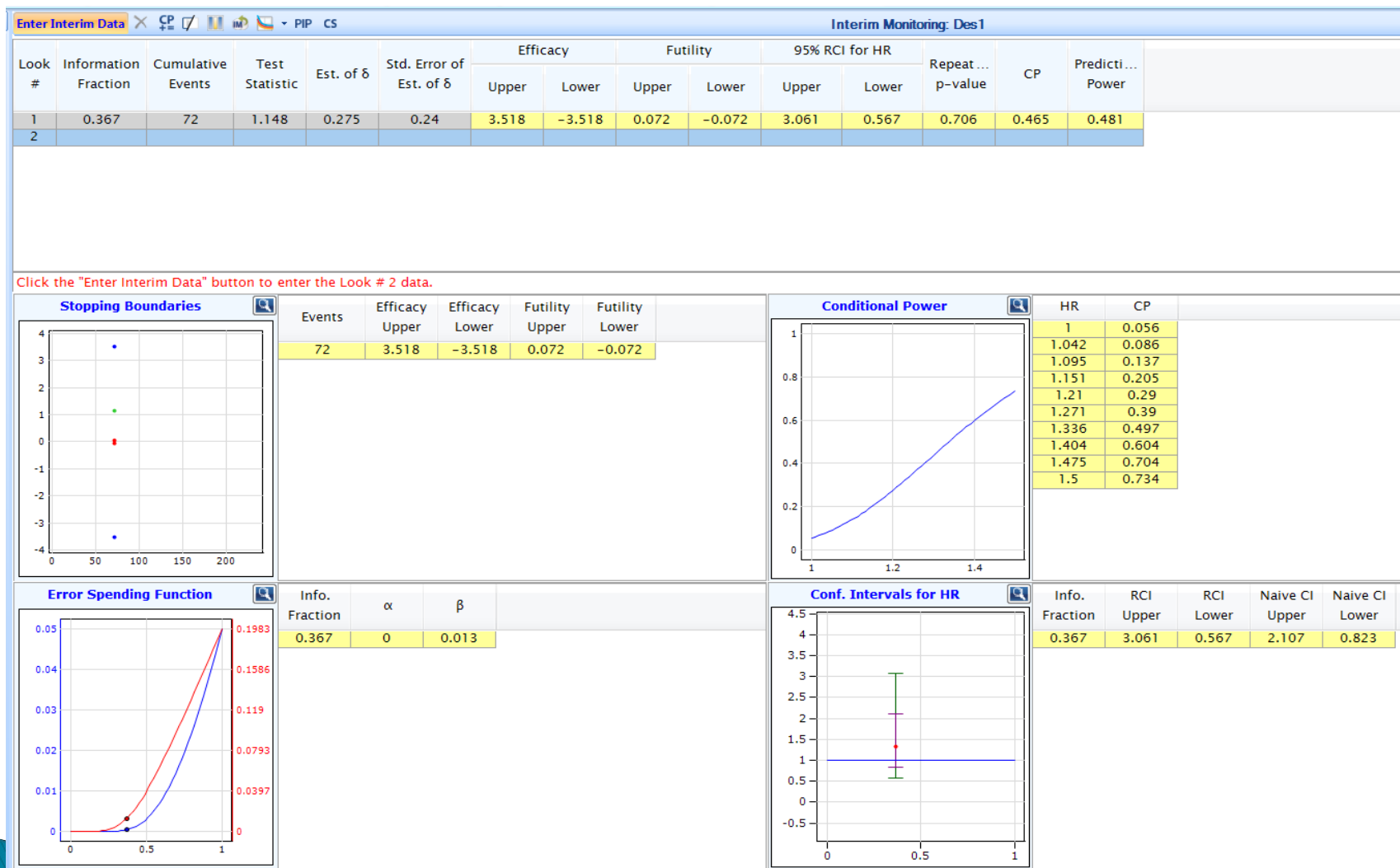
Standard Error of Estimate of δ : 0.23973

Output

Test Statistic: 1.148

Recalc OK Cancel

Interim Analysis Results in EAST



(Attempted) Sample Size Calculation in PASS

PASS: Logrank Tests (Lakatos) [Median Survival Time]

File Run Means Proportions Correlation Regression Survival ROC Variances DOE Tools Win

RUN NEW OPEN SAVE PASS MAP OUT MACRO DIFFS 2 PROP 2 S T-TEST 1 WAY ANOVA RM ANOVA CNTRL MC-S HR LRANK LINEAR REG LOGIST REG

Symbols/Back Options Abbreviations Template

Data Reports Axes/Legend Plot Text Plot Type

Solve For

Find (Solve For):
N (Total Sample Size)

Error Rates

Power (1-Beta):
0.80

Alpha (Significance Level):
0.05

Sample Size

N (Total Sample Size):
500

Proportion in Control Group:
0.5

Proportion Lost or Switching Groups

Controls Treatments

Lost: 0.00 0.00

Switch to Treatments: 0.0 Switch to Controls: 0.0

Note: Proportions are for a single time period.

Effect Size

T1 (Median Survival Time - Control):
30

Treatment Group Parameter:
T2 (Med. Survival Time - Treatment)
T2 (Median Survival Time - Treatment):
20

HR (Hazard Ratio = T1/T2):
0.5

Parameter Conversion

Duration

Accrual Time (Integers Only):
730

Accrual Pattern:
Equal

Total Time (Integers Only):
910

Test

Alternative:
Two-Sided

Spreadsheet

Spreadsheet

Interim Analysis Design in PASS

PASS: Group-Sequential Logrank Tests

File Run Means Proportions Correlation Regression Survival ROC Variances DOE Tools

RUN NEW OPEN SAVE PASS MAP OUT MACRO DIFFS 2-5 T-TEST 1-WAY ANOVA RM ANOVA CONTL M-G-S HR LRANK LINEAR REG

Symbols/Back End Plot Axes Options Template

Data Reports Axes/Legend Plot Text Plot Type

Solve For

Find (Solve For):
Power and Beta

Error Rates

Power (1-Beta):
.80

Alpha (Significance Level):
0.05

Sample Size

N (Total Sample Size):
198

Test

Alternative Hypothesis:
Two-Sided

Survival Time Assumption:
Exponential Survival

Effect Size

S1 (Proportion Surviving 1):
9.84313320230369E-03

S2 (Proportion Surviving 2):
6.25000000000001E-02

Survival Parameter Conversion Tool

Look Details

Number of Looks: Boundary Truncation:
2 None

Spending Function: Max Time:
O'Brien-Fleming 198

Times:
85 198

Informations:
0.4292 1.00

Upper Boundaries (Spending = User):
0.25 0.75

Lower Boundaries (Spending = User):

Default values
(not yet
changed)

Interim Analysis Design in PASS

Survival Parameter Conversion Tool

Survival Parameters | Proportions (Years to Months)

Use this window to convert among various survival distribution parameters (assumes an exponential survival distribution). The appropriate values may then be copied and pasted.

Survival Parameters

Time (T0): Changing a value will cause all appropriate values to be updated.

Hazard Ratio (h1/h2): Hazard Ratio (h2/h1):

Mortality Ratio (M1/M2): Mortality Ratio (M2/M1):

Group 1 **Group 2**

Hazard Rate (h1): Hazard Rate (h2):

Proportion Surviving Past T0 (S1): Proportion Surviving Past T0 (S2):

Mortality until T0 (M1): Mortality until T0 (M2):

Median Survival Time (T1): Median Survival Time (T2):

Interim Analysis Calculations in PASS

Numeric Results for Two-Sided Logrank Test (Assuming Exponential Survival)

Power	Total Sample Size (N)	Total Required Events	Alpha	Beta	Proportion Surv. (S1)	Proportion Surv. (S2)	Hazard Ratio
0.941273	198	191	0.050000	0.058727	0.0098	0.0625	0.6000

Summary Statements

A total sample size of 198 (split equally between the two groups), or 191 events, achieves 94% power to detect a hazard rate of 0.6000 when the proportions surviving in each group are 0.0098 and 0.0625 at a significance level (alpha) of 0.050000 using a two-sided log rank test. These results assume that 2 sequential tests are made using the O'Brien-Fleming spending function to determine the test boundaries and that the survival times are exponential.

Details when Spending = O'Brien-Fleming, N = 198, d = 191, S1 = 0.0098, S2 = 0.0625

Look	Total Time Power	Info	Lower Bndry	Upper Bndry	Nominal Alpha	Inc Alpha	Total Alpha	Inc Power
1	85.0000 0.179880	0	-3.22763	3.22763	0.001248	0.001248	0.001248	0.179880
2	198.0000 0.941273	1	-1.96357	1.96357	0.049580	0.048751	0.050000	0.761393
Drift	3.52838							

Summary of Results

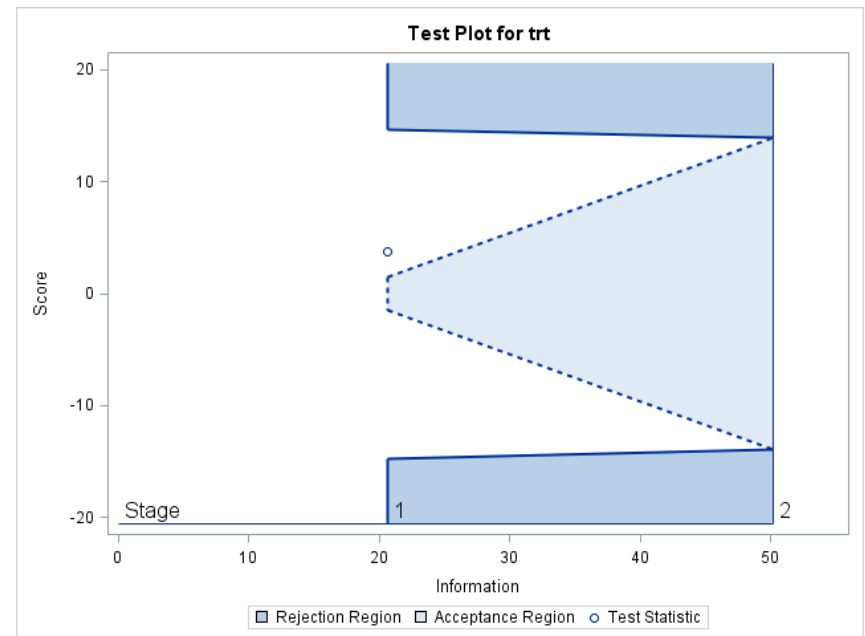
- ▶ SAS Proc Power and Proc Seqdesign may give different overall sample size calculations (different algorithms)
- ▶ Interim analysis design similar between SAS Proc Seqdesign, EAST, and PASS
- ▶ SAS and EAST will perform interim analyses but need additional software from PASS manufacturer to perform it
- ▶ Estimated information levels & cutoffs change between design & analyses (censoring)

Variations: Proc Seqdesign vs Seqtest

Results: If I had 85 pts w/ data (103 total)

Test Information (Score Scale) Null Reference = 0										
-Stage-	Information Level		Alternative Reference		Boundary Values				Test TRT	
	Proportion	Actual	Lower	Upper	Lower		Upper		Estimate	Action
					Alpha	Beta	Beta	Alpha		
1	0.4115	20.6222	-8.36169	8.36169	-14.7122	-1.44551	1.44551	14.7122	3.71791	Continue
2	1.0000	50.1183	-20.3215	20.3215	-13.9038	-13.9038	13.9038	13.9038	.	

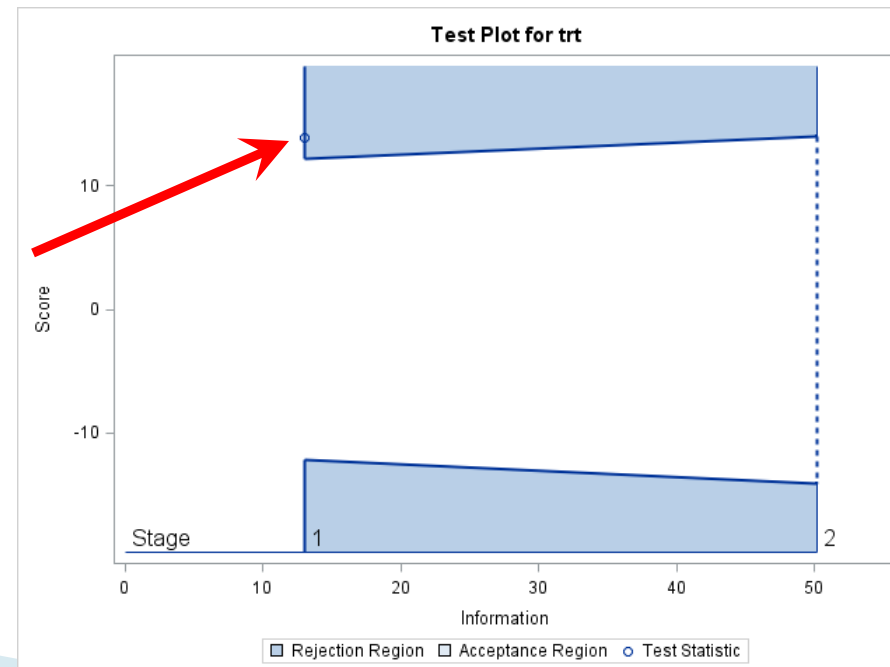
- 103 pts = 85 not censored
- Still not 0.4293 of info
- Interim boundaries not ± 1.635 & ± 14.97
- Final boundaries close but not exact (± 13.90099)
- Middle of graph *does* show
- Still continue



Variations: When would I consider stopping for efficacy?

Test Information (Score Scale) Null Reference = 0									
Stage	Information Level		Alternative Reference		Boundary Values				Test
					Lower		Upper		TRT
	Proportion	Actual	Lower	Upper	Alpha	Beta	Beta	Alpha	Estimate Action
1	0.2598	13.0219	-5.28000	5.28000	-12.156	.	.	12.156	13.9049 Reject Null
2	1.0000	50.1183	-20.3215	20.3215	-14.081	-14.081	14.081	14.081	.

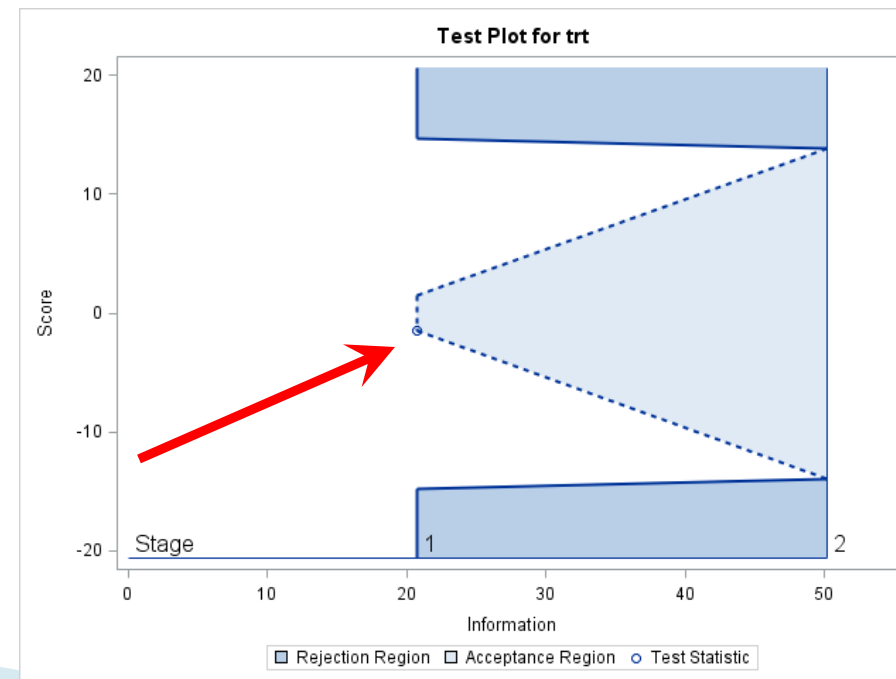
- ▶ Changed Trt A mean duration to 10 days (vs 30d) in dummy trial (previously 20d vs 30d)
- ▶ Graph shows dot in rejection region
- ▶ Action="Reject Null"



Variations: When would I consider stopping for futility?

Test Information (Score Scale) Null Reference = 0										
Stage	Information Level		Alternative Reference		Boundary Values				Test TRT	
	Proportion	Actual	Lower	Upper	Lower		Upper		Estimate	Action
					Alpha	Beta	Beta	Alpha		
1	0.4128	20.6891	-8.3888	8.3888	-14.732	-1.4592	1.4592	14.732	-1.45914	Accept Null
2	1.0000	50.1183	-20.3215	20.3215	-13.904	-13.904	13.904	13.904	.	

- ▶ Changed Trt A mean duration to 29 days (vs 30d) & removed censoring in dummy trial (previously 20d vs 30d)
- ▶ Graph shows dot in rejection region
- ▶ Action="Accept Null"



Final Analyses

- ▶ After performing an interim analysis, you need to adjust the final analysis for “double dipping”
- ▶ With a single interim analysis, typically very small adjustment
- ▶ Multiple interims can result in large adjustments (final results must be more significant)
- ▶ In SAS: Perform same steps (Seqdesign, Lifetest, Seqtest), indicating that parameter values from Lifetest are for `_STAGE_ = 2`

Suggestions / Recommendations

- ▶ Virtually every study has dropout and resulting censoring of time-to-event data
- ▶ Cutoff values are likely to change between interim analysis design and actual interim analysis
- ▶ Clearly specify how analysis will be performed (which method, etc.) but avoid stating specific boundary values in protocol or SAP
- ▶ Consider stating that interim analysis will be performed after information is available on “approximately xx subjects” or “after xx subjects have completed xx time on study or withdrawn from study”

Thank you!

Comments welcomed:
bowden.analytics@gmail.com