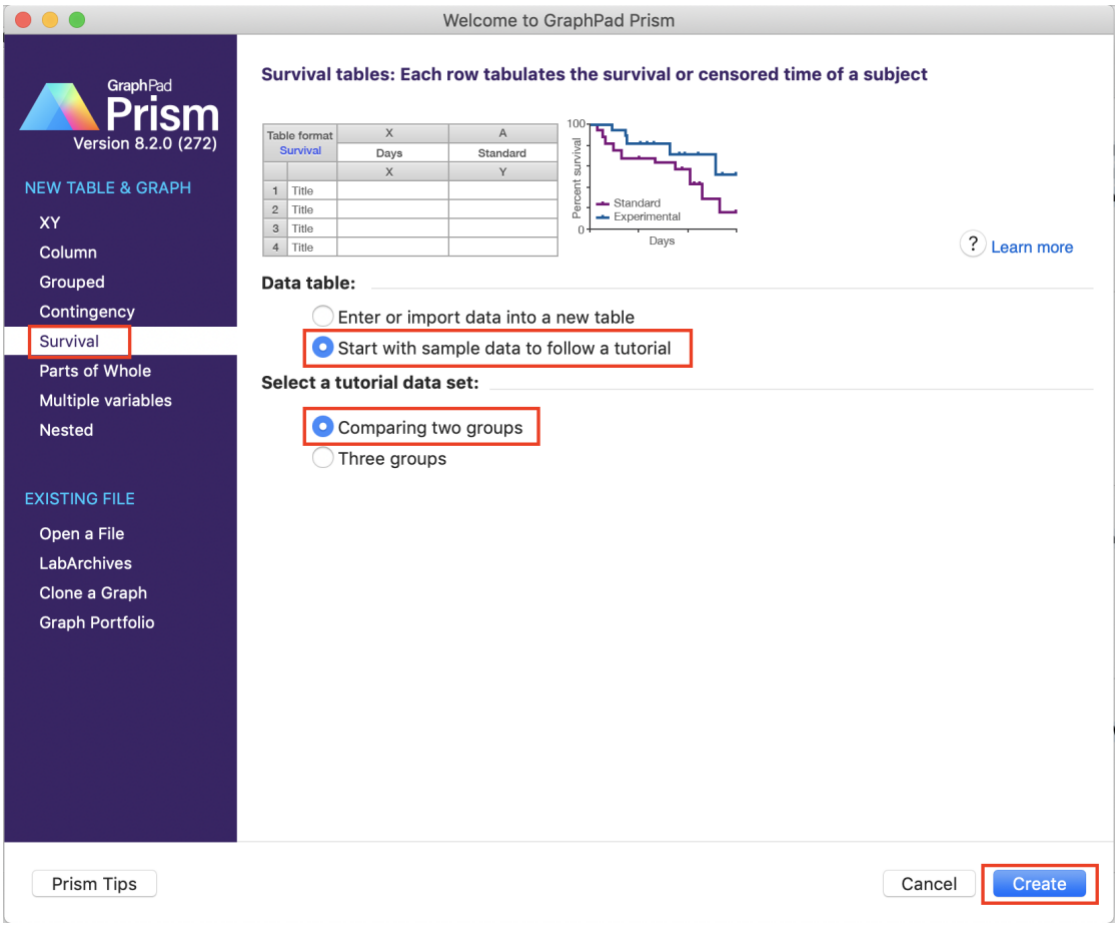
Survival Analysis

Qinlu (Claire) Wang
BCBB/OCICB/NIAID

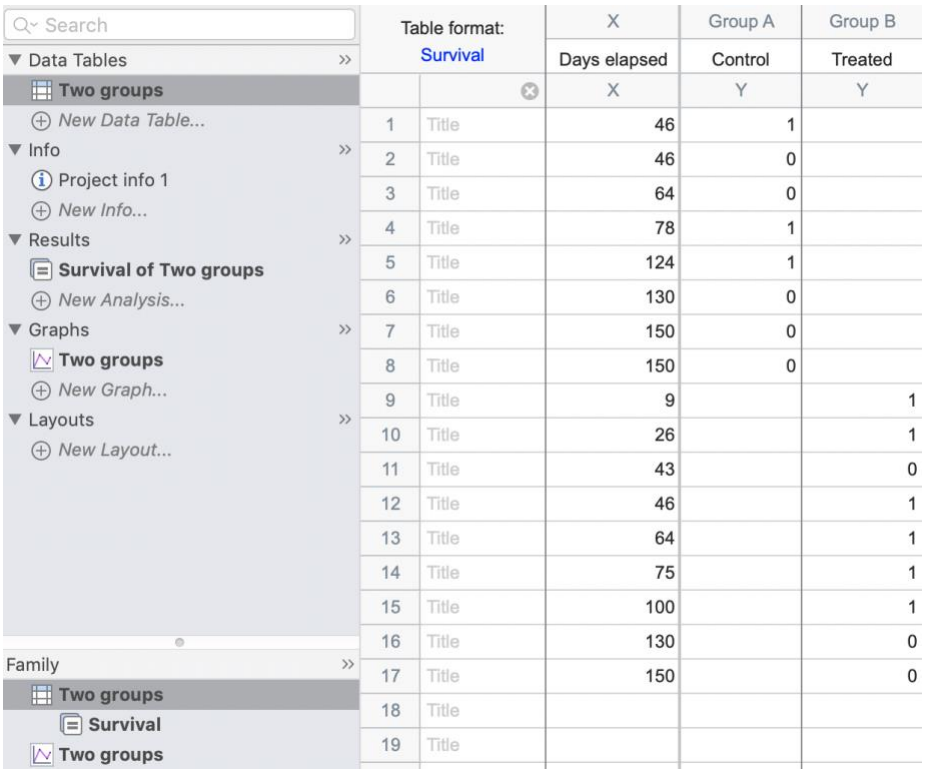
1. **Create a survival table**

   From the Welcome or New Table dialog, **choose the Survival tab**. **Choose "Start with sample data**



   to follow a tutorial" then **"Comparing two groups"**. **Click "Create"**.

   The data will be like:

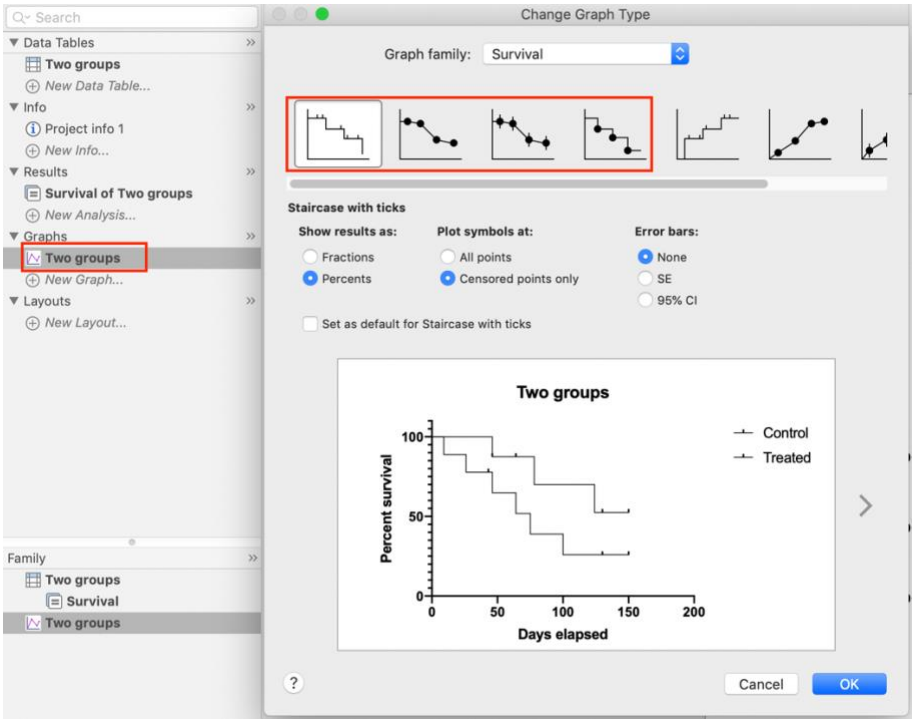


		X	Group A	Group B
		Days elapsed	Control	Treated
		X	Y	Y
1	Title	46	1	
2	Title	46	0	
3	Title	64	0	
4	Title	78	1	
5	Title	124	1	
6	Title	130	0	
7	Title	150	0	
8	Title	150	0	
9	Title	9		1
10	Title	26		1
11	Title	43		0
12	Title	46		1
13	Title	64		1
14	Title	75		1
15	Title	100		1
16	Title	130		0
17	Title	150		0
18	Title			
19	Title			

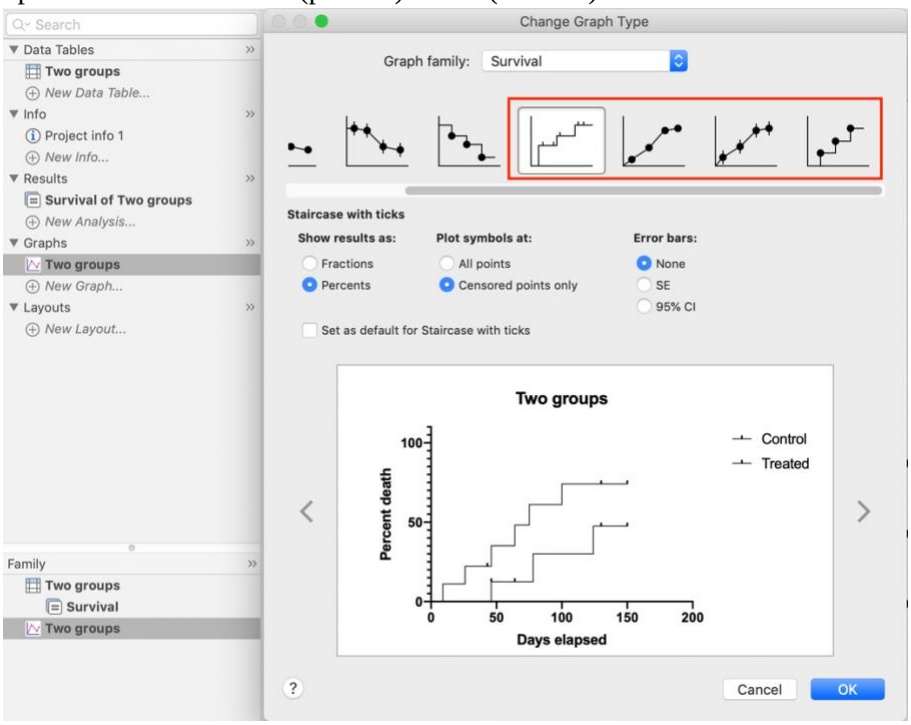
"1" is for rows where the subject died (or the event occurred) at the time shown in the X column. "0" is for rows where the subject was censored at that time. Every subject in a survival study either dies or is censored.

Similar with other analyses, Prism automatically analyzes and graphs your survival data. When you first go look at the graph, Prism pops up a dialog where you can customize the graph.

The first 4 options with decreasing trends are survival graphs which start at 100% (or 1.0) and go down to zero.



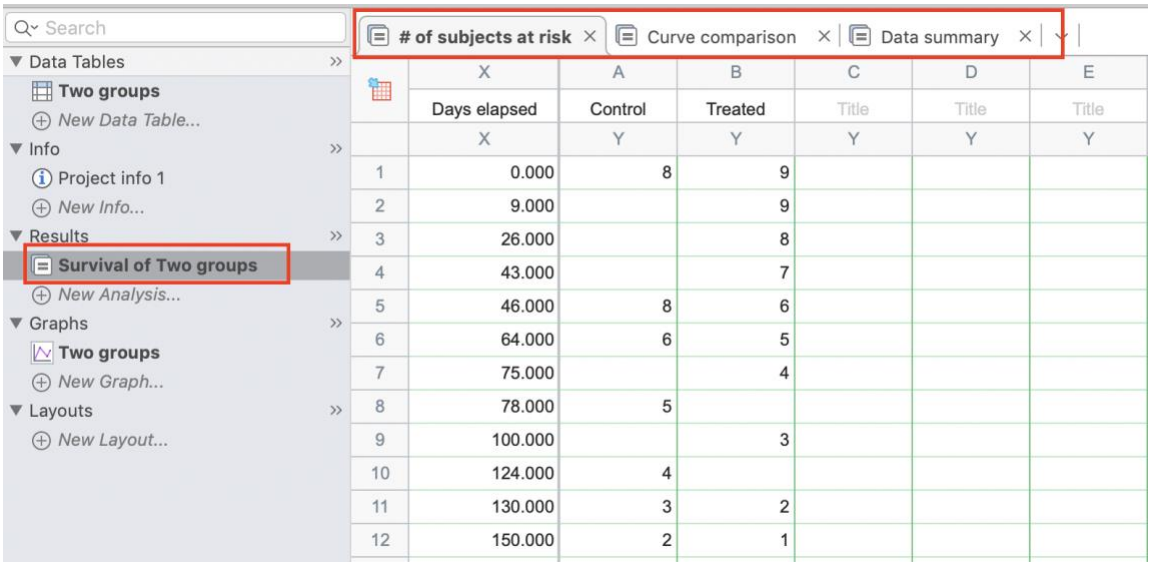
The later 4 graphs with increasing trends are *Cumulative incidence graphs* which start at 0 and go up to a maximum of 100 (percent) or 1.0 (fraction).



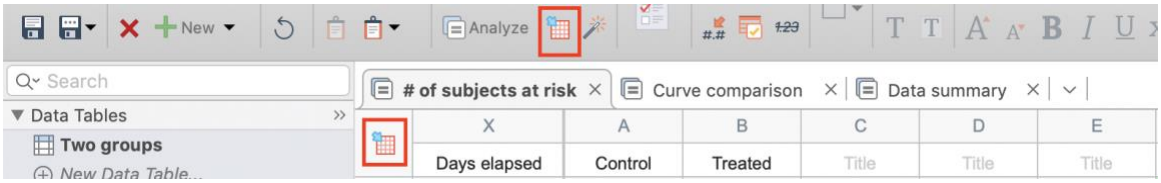
2. Survival Analysis

The survival analysis is unique in Prism. When you enter data on a survival table, Prism automatically performs the analysis. You don't need to click Analyze or make any choices on the parameters dialog.

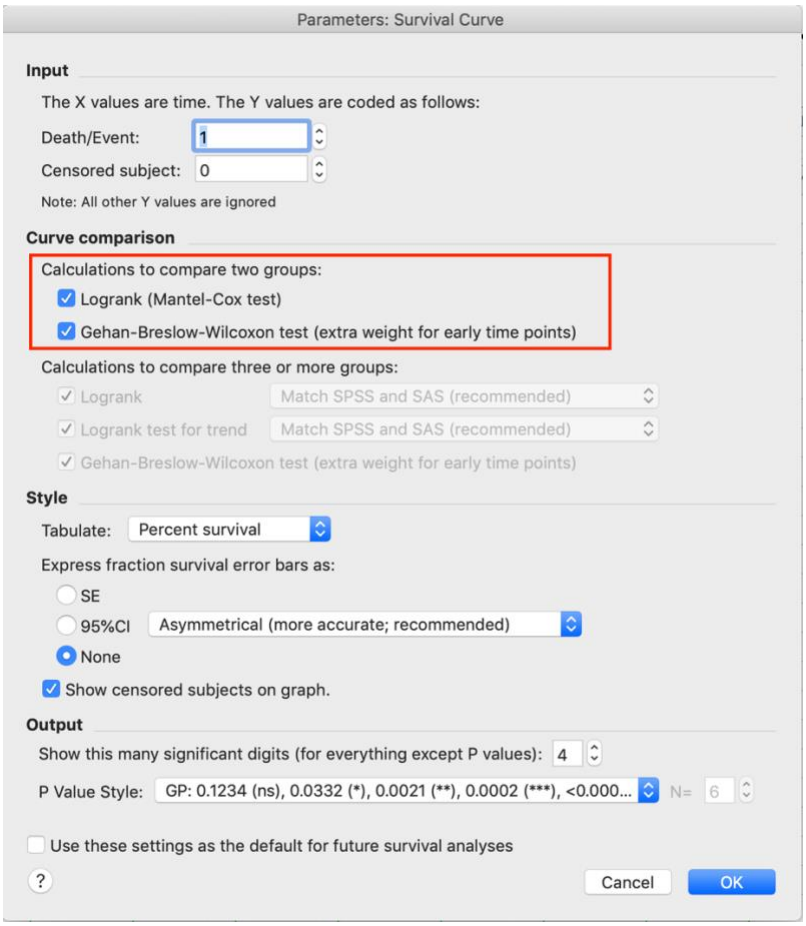
Click the result "Survival of Two groups". The result includes number of subjects at risk, curve comparison and data summary respectively.



If you would like to make any changes, you could **click the analysis parameter buttons** to bring up the parameters dialog.



In the parameters dialog, there are two methods for the comparison between two survival curves.



The comparison between log-rank test and Gehan-Breslow-Wilcoxon test:

Log-rank Test	Gehan-Breslow-Wilcoxon test
• Gives equal weights to all time points • **More standard** • More powerful if the assumptions of proportional hazards** is true.	• Gives more weight to deaths at early time points • The results can be misleading when a large fraction of patients is censored at early time points. • Doesn't require a consistent hazard ratio, but does require that one group consistently have a higher risk than the other.

** Proportional hazards mean that the ratio of hazard functions (deaths per time) is the same at all time points. One example of proportional hazards would be if the control group died at twice the rate as treated group at all time points.

3. Interpreting results: Survival Analysis

1) Number of subjects at risk at various times

The results are shown in the first tab of the "Survival of two groups" results

# of subjects at risk | Curve comparison | Data summary

	X	A	B	C	D
	Days elapsed	Control	Treated	Title	Title
	X	Y	Y	Y	Y
1	0.000	8	9		
2	9.000		9		
3	26.000		8		
4	43.000		7		
5	46.000	8	6		
6	64.000	6	5		
7	75.000		4		
8	78.000	5			
9	100.000		3		
10	124.000	4			
11	130.000	3	2		
12	150.000	2	1		

For example, for the control group, the experiment starts with 8 subjects receiving standard / control therapy. There are still 8 subjects at risk at the beginning of day 46, and this is shown on the table. During day 46, one of the patients receiving standard therapy died and the data for another was censored. Therefore, 6 patients remain at risk between day 46 and the beginning of day 64, and this tabulated. On day 64, data on another patient is censored, so 5 patients are at risk until the beginning of day 78. The next death occurs on day 78, so 4 subjects are at risk until the beginning of day 124....

2) P-value

The p-values are shown in the 2nd tab of the "Survival of two groups" results:

# of subjects at risk | Curve comparison | Data summary

Survival
Curve comparison

1	**Comparison of Survival Curves**			
2				
3	**Log-rank (Mantel-Cox) test**			
4	Chi square	2.010		
5	df	1		
6	P value	0.1563		
7	P value summary	ns		
8	Are the survival curves sig differer	No		
9				
10	**Gehan-Breslow-Wilcoxon test**			
11	Chi square	2.532		
12	df	1		
13	P value	0.1115		
14	P value summary	ns		
15	Are the survival curves sig differer	No		
16				
17	**Median survival**			
18	Control	Undefined		
19	Treated	75.00		
20				
21	**Hazard Ratio (Mantel-Haenszel)**	**A/B**	**B/A**	
22	Ratio (and its reciprocal)	0.3801	2.631	
23	95% CI of ratio	0.09977 to 1.448	0.6907 to 10.02	
24				
25	**Hazard Ratio (logrank)**	**A/B**	**B/A**	
26	Ratio (and its reciprocal)	0.3863	2.589	
27	95% CI of ratio	0.1034 to 1.442	0.6933 to 9.668	

The P value tests the null hypothesis that the survival curves are identical in the overall populations. In other words, the null hypothesis is that the treatment did not change survival. The P value answers this question:

- If the null hypothesis is true, what is the probability of randomly selecting subjects whose survival curves are as different (or more so) than was actually observed?

3) Hazard Ratio
   - Hazard is defined as the slope of the survival curve — a measure of how rapidly subjects are dying.
   - The hazard ratio compares two treatments. <u>If the hazard ratio is 2.0, then the rate of deaths in one treatment group is twice the rate in the other group.</u>
   - The hazard ratio is not computed at any one time point, but is computed from all the data in the survival curve.
   - Since there is only one hazard ratio reported, it can only be interpreted if you assume that the population hazard ratio is consistent over time, and that any differences are due to random sampling. This is called the assumption of *proportional hazards*.

- More about Hazard Ratios could be found at Interpreting results: The hazard ratio.

Conclusion

If you have any question about how to do the survival analysis in Prism 8, please feel free to contact me (qinlu.wang@nih.gov) or our BCBB (bioinfomatics@niaid.nih.gov)

Reference

Survival Analysis by Prism