Fold Change (Fail)

I did an experiment and got the result as fold change. Experiment was repeated three times. Following is the result:

- 1) Control = 1, 1, 1
- 2) Test = 2.2, 2.4, 2.6 (fold change)

I have several doubt over using statistical test.

- a) I think I can not use parametric test because sample size is only three and normal distribution can not be determined for this.
- b) All control samples have same value so standard deviation can not be calculated.
- c) Can I apply any non-parametric test in this case?

Pseudoreplication

Classic "fails" in molecular biology experimentation:

- (1) The "triplicate"
- (2) The "representative graph"
- (3) P-hacking

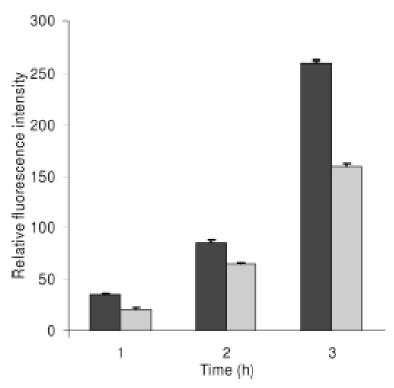


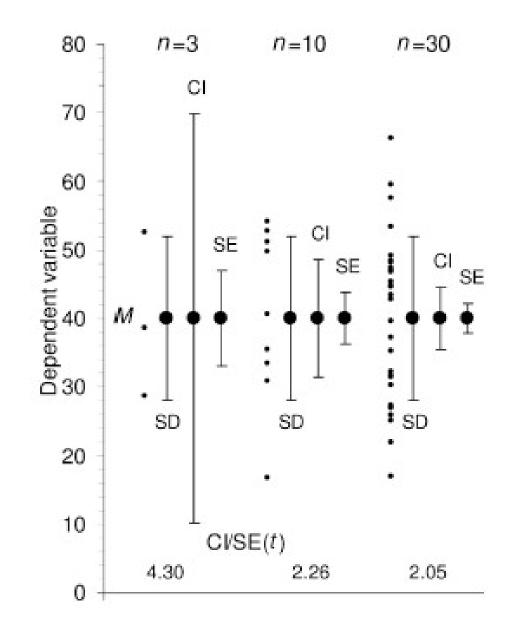
Figure 3. Inappropriate use of error bars. Enzyme activity for MEFs showing mean + SD from duplicate samples from one of three representative experiments. Values for wild-type vs. -/- MEFs were significant for enzyme activity at the 3-h timepoint (P < 0.0005). This figure and its legend are typical, but illustrate inappropriate and misleading use of statistics because n=1. The very low variation of the duplicate samples implies consistency of pipetting, but says nothing about whether the differences between the wild-type and -/- MEFs are reproducible. In this case, the means and errors of the three experiments should have been shown.

Sample Size & Confidence Interval

As you add data, you approach the "true mean" and your confidence of what the true mean is increases.

(Statistical consistency.)

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0086391



BIG DATA TABLES: Metagenomics, Metabolomics, Gene Expressions patterns, Codon bias tables...etc.

Focus on diversity metrics and microbial communities.

FeatureTable[Fred	quency]					
	feature1	fea 2	ture	feature 3	feature 4	feature 5
gut2	84	1		73	198	2
left.palm2	24	2		44	176	1
right.palm2	11	0		10	30	0
tongue2	0	0		25	2	0

	Total frequency
gut2	358
left.palm2	247
right.palm2	51
tongue2	27

Comparing microbial communities

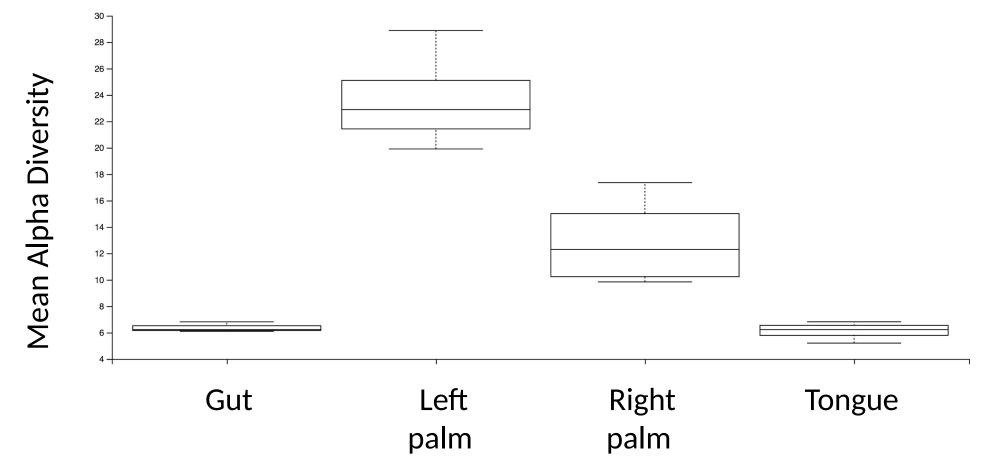
How many "species" are there? Alpha diversity (richness, evenness, or both).

How similar are pairs of samples? Beta diversity

Who is there? Taxonomic profiling, differential abundance testing.

Alpha diversity comparison

- visually with distribution comparison plots (discrete data) or scatter plots (continuous data)
- statistically with Kruskal-Wallis (discrete data) or Spearman correlation (continuous data)



Alpha diversity metrics

operate on a single sample (i.e., within sample diversity).

Beta diversity metrics

operate on pairs of samples (i.e., between sample diversity).

Qualitative diversity metrics only consider the presence/absence of features.

Quantitative diversity metrics consider

ALPHA DIVERSITY

Observed OTUs (or Observed Species): a qualitative, non-phylogenetic, alpha diversity metric

FeatureTable[Free	quency]			,			SampleData[AlphaDive	rsity]
	feature1	feature 2	feature 3	feature 4	feature 5			Observed OTUs
gut3	25	30	15	0	0		gut3	TOTAL?
left.palm3	0	17	33	25	0	·	left.palm3	TOTAL?

Count the number of different features in a sample.

ALPHA DIVERSITY

Observed OTUs (or Observed Species): a qualitative, non-phylogenetic, alpha diversity metric

FeatureTable[Free	quency]			,		SampleData[AlphaDive	ersity]
	feature1	feature 2	feature 3	feature 4	feature 5		Observed OTUs
gut3	25	30	15	0	0	 gut3	3
left.palm3	0	17	33	25	0	left.palm3	3

Count the number of different features in a sample.

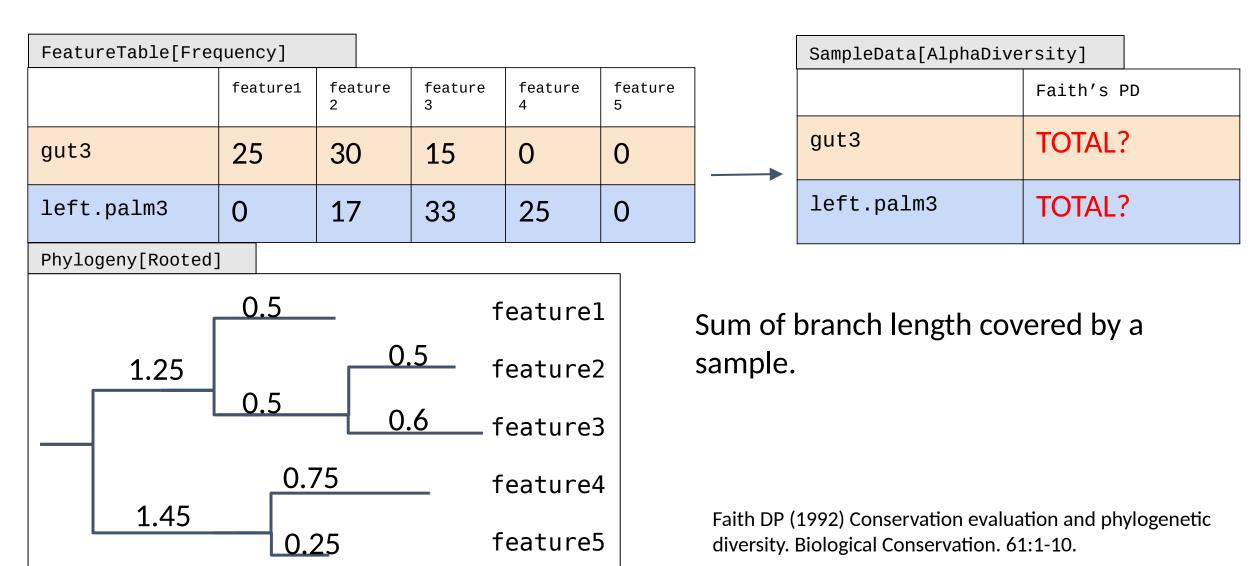
Why incorporate phylogeny in a diversity metric?

FeatureTable[Free	quency]					7	SampleData[AlphaDive	ersity]
	feature1	feature 2	feature 3	feature 4	feature 5			Observed OTUs
gut3	25	30	15	0	0		gut3	3
left.palm3	0	17	33	25	0		left.palm3	3

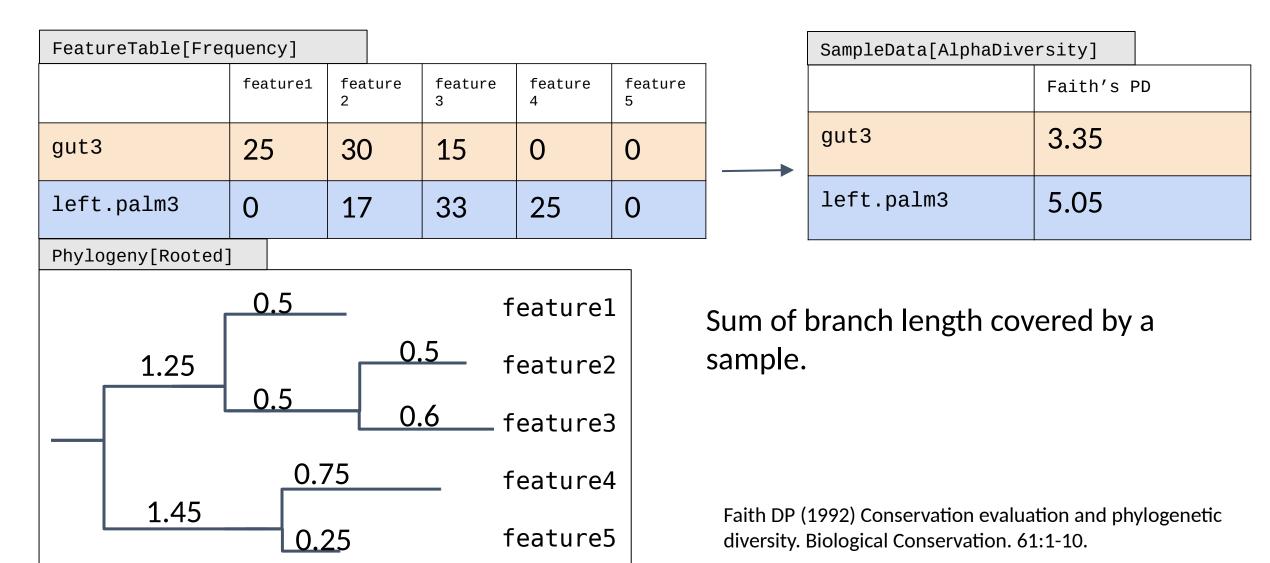
Phylogeny[Roo	ced]	
	0.5	feature1
1.25	0.5	feature2
	0.5	feature3
	0.75	feature4
1.45	0.25	feature5

FeatureData[Taxor	nomy]
	Domain
feature1	Bacteria
feature2	Bacteria
feature3	Bacteria
feature4	Archaea
feature5	Archaea

Faith's Phylogenetic Diversity (PD): a qualitative, phylogenetic, alpha diversity metric



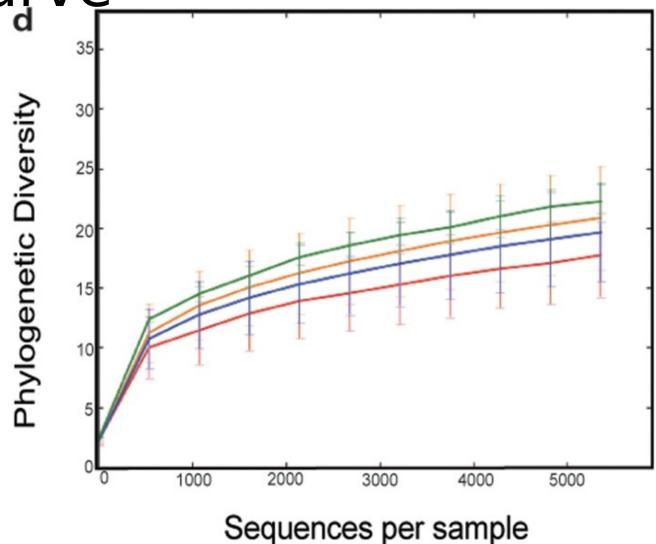
Faith's Phylogenetic Diversity (PD): a qualitative, phylogenetic, alpha diversity metric

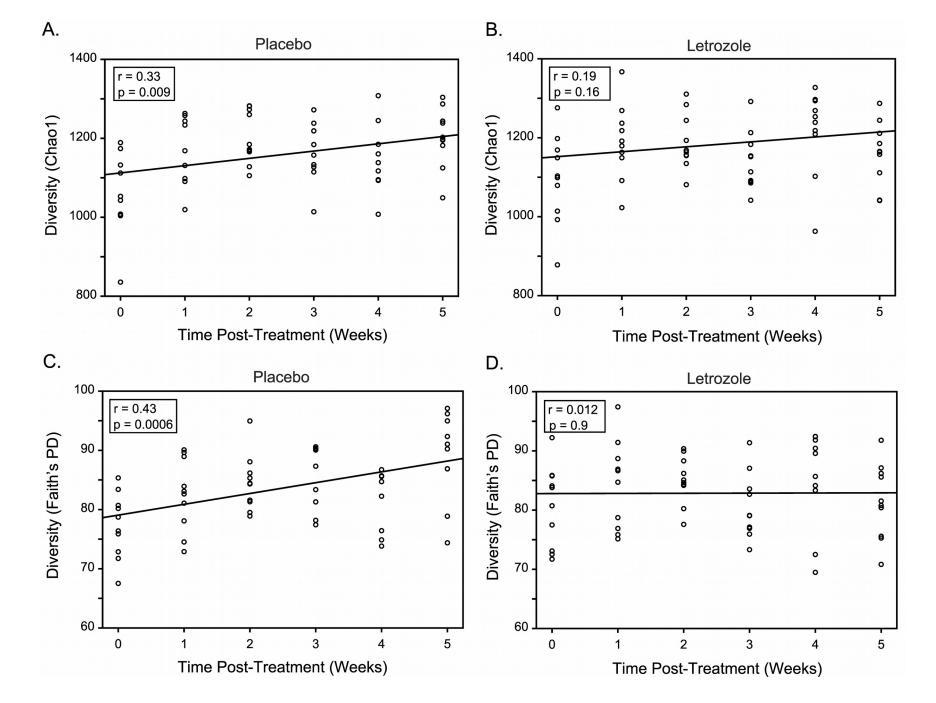


Rarefaction Curve

Q1) What if I have different sampling or sequencing for each sample?

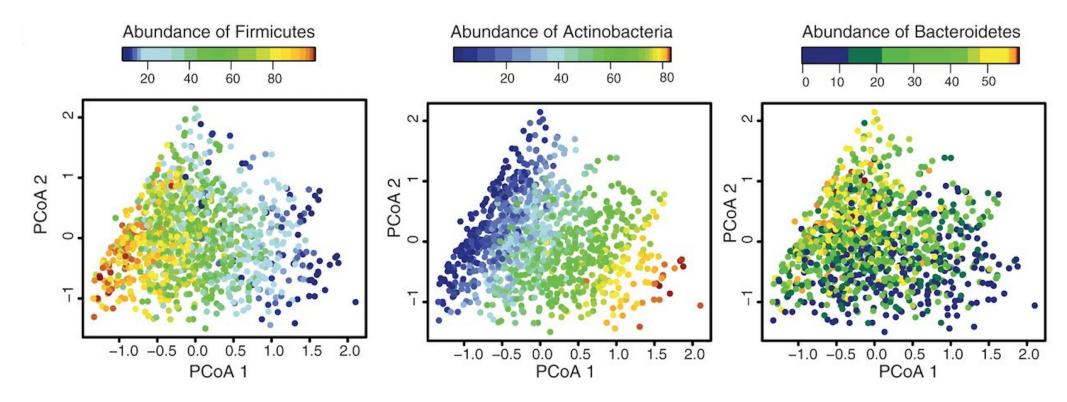
Q2) What happens if I change the sampling levels?





Beta diversity comparison

- visually with ordination plots (e.g., NMDS or PCoA; discrete or continuous data) or distribution box plots (discrete data)
- statistically with Kruskal-Wallis (discrete data), Mantel correlation (continuous data) or BEST (continuous data)



Jaccard distance: a qualitative, non-phylogenetic beta diversity metric

FeatureTable[Fre	quency]						J(A,	B)	=	1		$A \cup B$
	feature1	feature 2	feature 3	feature 4	featu 5	ıre					71	$oldsymbol{O}$
gut1	42	0	37	99	1		\					
left.palm1	10	1	22	00	0	Di	stanceMatrix					
Terc.parmi	12	1	22	88	0			gut1	lef	ŧ.	right.	tongue1
right.palm1	25	3	23	86	0				pal	_m1	palm1	
1 Igne i paimi	23	3	23	00		an	ıt1					
tongue1	0	0	87	12	0		. C I					
				14		1e	eft.palm1					
							71 C 1 PQ 2 2					
						ri	ight.palm1					
						to	ongue1					

Jaccard distance: a qualitative, non-phylogenetic beta diversity metric

FeatureTable[Fre	guency1						J(A,	B)	=	1		$B \rightarrow B$
	feature1	feature 2	feature 3	feature 4	featu 5	ıre					A	$A \cup B$
gut1	42	0	37	99	1		+					
left.palm1	12	1	22	88	0	Dis	stanceMatrix					
τει τι ρατιιιτ	12	1	22	00	U			gut1	lef	t.	right.	tongue1
right.palm1	25	3	23	86	0				pal	m1	palm1	
1 191101 parimi	23	3	23	00		gu	ı†1	0.0				
tongue1	0	0	87	12	0	95.						
<u> </u>				+4		le	ft.palm1		0.0			
								VAL?				
						ri	.ght.palm1				0.0	
						to	ngue1					0.0

Jaccard distance: a qualitative, non-phylogenetic beta diversity metric

						Ιίλ	\boldsymbol{R}	_ 1	<i>B</i>	$\Box B$
FeatureTable[Fre	quency]					$_{-}$ $J(\Lambda$, B)	= 1	Δ	$\cup B$
	feature1	feature 2	feature 3	feature 4	featu 5	re			7 1	
gut1	42	0	37	99	1	•				
left.palm1	12	1	22	88	0	DistanceMatrix				
τοι ειρατιίτ	12	1	22	00	U		gut1	left.	right.	tongue1
right.palm1	25	3	23	86	0			palm1	palm1	
	23	3	25	00		gut1	0.0			
tongue1	0	0	87	12	0	9				
-						left.palm1	0.4	0.0		
						right.palm1	0.4	0.0	0.0	
						tongue1	0.5	0.5	0.5	0.0

Jaccard distance: a qualitative, non-phylogenetic beta diversity metric

FeatureTable[Fre	quency]					J(A,	B)	= 1		$\cup B$
	feature1	feature 2	feature 3	feature 4	featu 5	re				Λ	. O D
gut1	42	0	37	99	1	+					
left.palm1	12	1	22	88	0	DistanceMa	trix				
τοι ειρατιίτ	12		22	00	U			gut1	left.	right.	tongue1
right.palm1	25	3	23	86	0				palm1	palm1	
1 Igne i paimi	23	3	23	00		gut1		0.0	0.4	0.4	0.5
tongue1	0	0	87	12	0	guer					
				12		left.palm	n1	0.4	0.0	0.0	0.5
						To re r pari					
						right.pal	Lm1	0.4	0.0	0.0	0.5
						tongue1		0.5	0.5	0.5	0.0

Bray-Curtis distance: a quantitative, non-phylogenetic beta diversity metric

FeatureTable[Fre	quency]						BC	C(A, B)	3) =	$\frac{\sum_{i} X_{i}}{\sum_{i} X_{i}}$	$\frac{(A - X_{iB})}{(A + X_{iB})}$
	feature1	feature 2	feature 3	feature 4	featu 5	re		frequency			
gut1	42	0	37	99	1		Į.	, ,		·	
left.palm1	12	1	22	88	0	Di	stanceMatrix				ı
	12	T		00	0			gut1	left.	right.	tongue1
right.palm1	25	3	23	86	0				palm1	palm1	
			_			gu	it1	0.0			
tongue1	0	0	87	12	0						
						le	ft.palm1		0.0		
						ri	.ght.palm1			0.0	
						to	ngue1	VAL?			0.0

Bray-Curtis distance: a quantitative, non-phylogenetic beta diversity metric

FeatureTable[Fre	quency]						BC	C(A, E)	3) =	$\frac{\sum_{i} X_{i}}{\sum_{i} X_{i}}$	$A - X_{iB}$	
	feature1	feature 2	feature 3	feature 4	featu 5	re	$BC(A, B) = \frac{\sum_{i} X_{iA} ^{-1}}{\sum_{i} (X_{iA} + X_{iA})^{-1}}$ $X_{iA} : \text{ frequency of feature } i \text{ in sample } A$					
gut1	42	0	37	99	1		1 1			·		
left.palm1	12	1	22	88	0	Di	stanceMatrix				T	
•	12	_		00				gut1	left. palm1	right. palm1	tongue1	
right.palm1	25	3	23	86	0				ратшт	ратшт		
						gu	t1	0.0				
tongue1	0	0	87	12	0	le	ft.palm1	0.19	0.0			
						ri	ght.palm1	0.15	0.07	0.0		
						to	ngue1	0.65	0.69	0.70	0.0	

Bray-Curtis distance: a quantitative, non-phylogenetic beta diversity metric

FeatureTable[Frequency]							BC	(A, B)) =	$\sum_{i} X_{iA}$	$-X_{iB}$	
	feature1	feature 2	feature 3	feature 4	featu 5	ıre		$C(A, B) = \frac{\sum_{i} X_{iA} - X_{iB} }{\sum_{i} (X_{iA} + X_{iB})}$ frequency of feature <i>i</i> in sample <i>A</i>				
gut1	42	0	37	99	1		•			·		
left.palm1	12	1	22	88	0	Di	stanceMatrix	gut1	left.	right.	tongue1	
right.palm1	25	3	23	86	0				palm1	palm1		
tongue1	0	0	87	12	0	gu	t1	0.0	0.19	0.15	0.65	
						le	ft.palm1	0.19	0.0	0.07	0.69	
						ri	ght.palm1	0.15	0.07	0.0	0.70	

tongue1

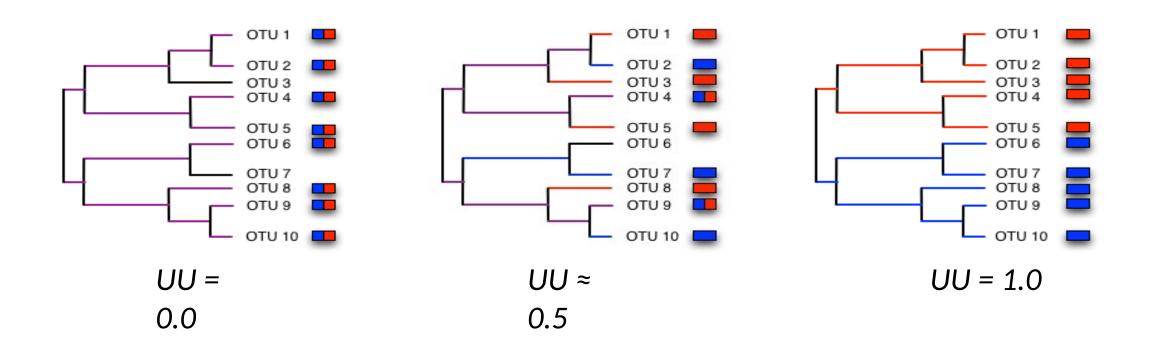
0.65

0.69

0.70

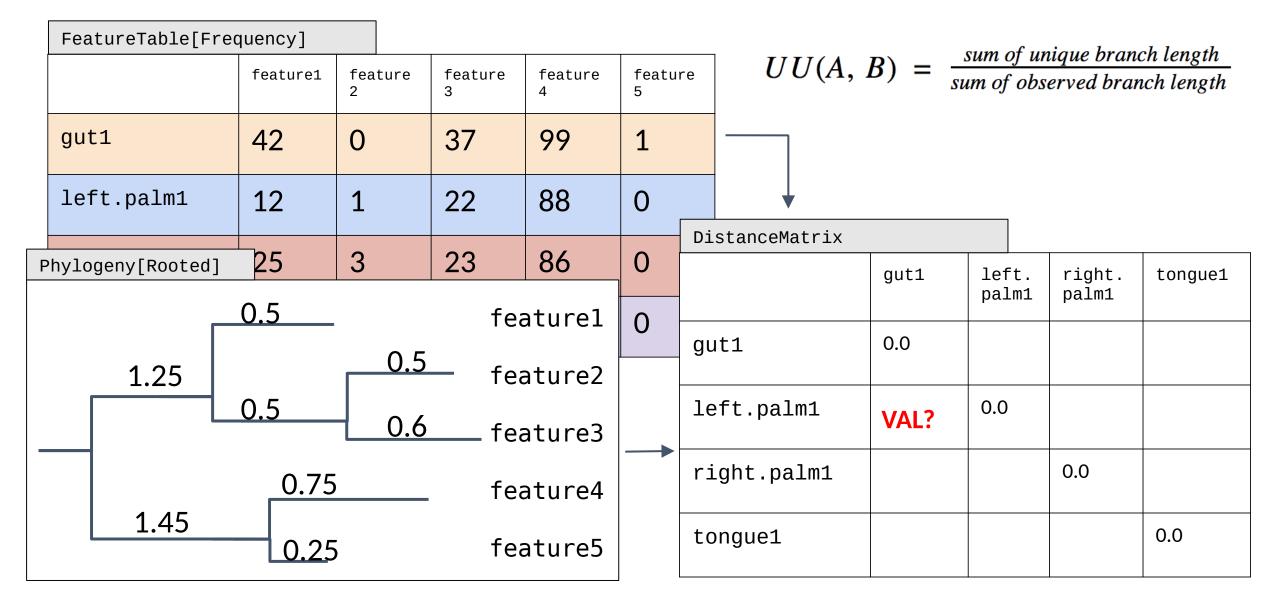
0.0

Unweighted UniFrac distance: a qualitative, phylogenetic beta diversity metric

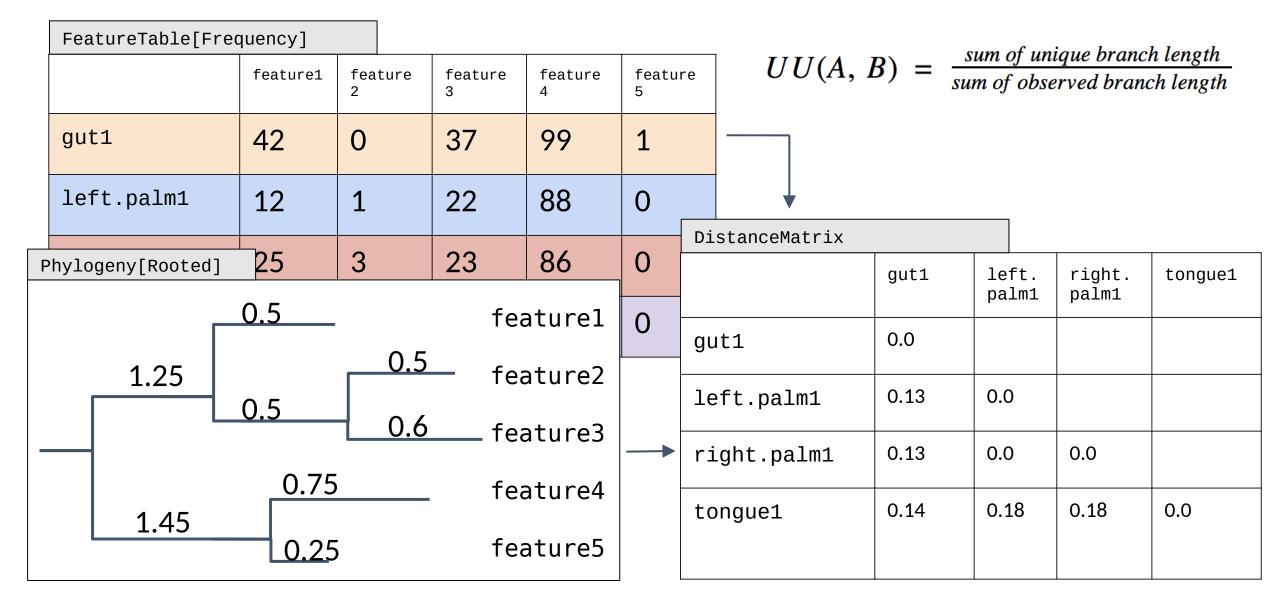


$$UU(A, B) = \frac{sum \ of \ unique \ branch \ length}{sum \ of \ observed \ branch \ length}$$

Unweighted UniFrac distance: a qualitative, phylogenetic beta diversity metric



Unweighted UniFrac distance: a qualitative, phylogenetic beta diversity metric

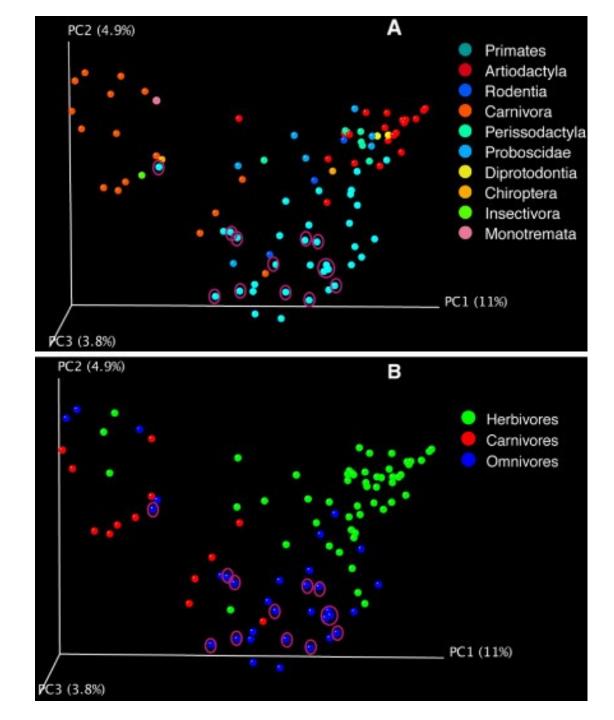


The first few lines of a relatively small distance matrix...

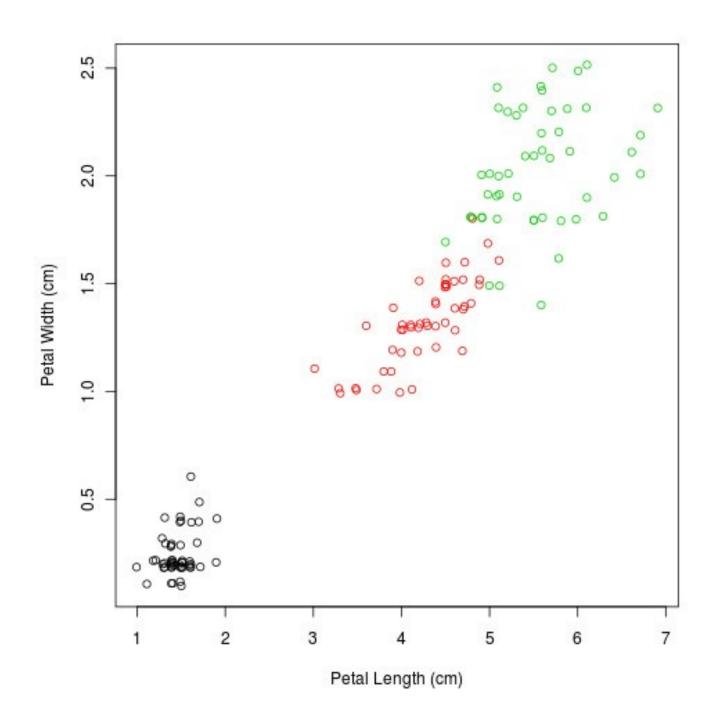
```
Stillton4R2 Stillton4R3 Stillton4R1 HCanyon3R3 HCanyon3R2 HCanyon3R1 Halls9R2 HCanyon2R2 HCanyon2R3 HCanyon2R1 Halls9R1 Stillton10R3
                                                                                                                                                                                                                                                                                                                                                                                                                   HCanyon@R1> HCanyon@R2> HCanyon@R3> HCanyon7R3> HCanyon7R2> HCanyon7R1> HCa
             Stillton4R2\0.0\0.382273294624\0.391416675288\0.560309484808\0.553938232028\0.566136031815\0.557134987546\0.531719852875\0.557041909667\0.574831935502\0.474244845718\0.776189708931\0.776189708931\0.797241309582\0.776189708931\0.797241309582\0.776189708931\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797241309582\0.797
            Stillton4R3 0.382273294624 0.0 0.394399899497 0.586303332083 0.583969320358 0.589363298118 0.58606262733 0.560923487354 0.5776776062 0.601572335069 0.609758664376 0.479910046195 0.779315452075 0.795032626325 0.7
             Stillton4R1 0.391416675288 0.394399899497 0.0 0.580628929798 0.580628929798 0.58463513906 0.573828216898 0.550892933103 0.566056393448 0.584611276938 0.607144746402 0.469209424282 0.781074100354 0.797809039119 0.7
             HCanyon3R2 0.553938232028 0.583969320358 0.583767102601 0.354600316745 0.0 0.36256949665 0.462707750398 0.414528760004 0.385453766442 0.380087766632 0.46109426257 0.574488221279 0.692644612288 0.714717508733
             HCanyon3R1 0.566136031815 0.589363298118 0.584463513906 0.345731612479 0.36256949665 0.0 0.452351806146 0.415483559719 0.398796424875 0.381981707704 0.485596583752 0.580926122772 0.683086513009 0.697490417772
                                         0.557134987546 \triangleright 0.588066262733 \triangleright 0.573828216898 \triangleright 0.458450145834 \triangleright 0.462707750398 \triangleright 0.452351806146 \triangleright 0.0 \triangleright 0.447883445295 \triangleright 0.429943464459 \triangleright 0.409064513124 \triangleright 0.344264504725 \triangleright 0.561110815583 \triangleright 0.727520276229 \triangleright 0.75335887058
             HCanyon2R2 0.531719852875 0.560923487354 0.550892933103 0.412488628393 0.414528760004 0.415483559719 0.447883445295 0.0 0.404179520995 0.388727659604 0.468345488157 0.549328940024 0.709578414217 0.723508997775
             HCanyon2R3 0.53655901824 0.57767776062 0.566330894525 0.385127601086 0.385453766442 0.388796424875 0.429943464459 0.404179520995 0.0 0.361444528983 0.439367245599 0.566330894525 0.711736423222 0.728837315629 0.7
             HCanyon2R1 > 0.567041909667 > 0.601572335069 > 0.584611276938 > 0.384525100123 > 0.380987766632 > 0.381981707704 > 0.409064513124 > 0.388727659604 > 0.361444528983 > 0.0 > 0.454633280595 > 0.582635621853 > 0.707912554104 > 0.722257776622 > 0.582635621853 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.707912554104 > 0.70791254104 > 0.70791254104 > 0.70791254104 > 0.70791254104 > 0.70791254104 > 0.70791
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             HCanyon0R1 0.776189708931 0.779315452075 0.781074100354 0.69071344042 0.692644612288 0.683086513009 0.727520276229 0.709578414217 0.711736423222 0.707912554104 0.745189206089 0.779519377947 0.0 0.387183864476 0.3
             HCanyon0R2 0.797241309582 0.795032626325 0.797809039119 0.713804444578 0.714717508733 0.697490417772 0.75335887058 0.72257776622 0.761081079305 0.79775580641 0.387183864476
             HCanyon0R3 0.784124036272 0.791711071574 0.795527048923 0.693476495058 0.699412891734 0.688360016409 0.732489014053 0.713925200799 0.708354096579 0.708462144382 0.747778043238 0.789044842767 0.384641076947 0.37153
             HCanyon7R3 0.539194289149 0.563745794923 0.557216919336 0.457709184042 0.467073058252 0.473888308307 0.42997132225 0.455576263999 0.448029116277 0.441566044862 0.444788573194 0.561681574866 0.740008927446
             HCanyon7R2 > 0.665877547192 > 0.665877547192 > 0.683833494738 > 0.674471865383 > 0.55308292175 > 0.563316168524 > 0.563316168524 > 0.5646938312206 > 0.558741865535 > 0.562533096516 > 0.534453165883 > 0.558141564634 > 0.657733284662 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084923 > 0.723347084924 > 0.723347084924 > 0.72347084924 > 0.72347084924 > 0.72347084924 > 0.72347084924 > 0.72347084924 > 0.72347084924
             HCanyon7R1 > 0.554857668962 > 0.578652540309 > 0.570402839551 > 0.475303182122 > 0.474309745536 > 0.462587318718 > 0.43076590681 > 0.463222699451 > 0.452021582021 > 0.42664191335 > 0.44552755863 > 0.564686335148 > 0.727314798211 > 0.75053
             HCanyon1R1 > 0.746066596617 > 0.754645795641 > 0.759778994683 > 0.654674045733 > 0.651121732227 > 0.640930093945 > 0.703134531793 > 0.67682938985 > 0.676955919301 > 0.714539249748 > 0.752511987622 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.451032388712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.45103288712 > 0.4510328712 > 0.4510328712 > 0.4510328712 > 0.4510328712 > 0.4510328712 > 0.45
             HCanyon1R3 0.751522854919 0.764074726397 0.767226018039 0.641176135477 0.65043468158 0.702785457767 0.675191090098 0.668258446703 0.66343689429 0.713256418398 0.763240754069 0.440489238658
21
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             HCanyon10R2 \ 0.56835786215 \ 0.584149104488 \ 0.584183423897 \ 0.466055758676 \ 0.464168854592 \ 0.470680372129 \ 0.458866733827 \ 0.4814190318 \
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             HCgnyon10R3 © 0.570798042641 © 0.588843077275 © 0.591942476159 © 0.50320590177 © 0.498220269993 © 0.503094520399 © 0.460532212318 © 0.496962587514 © 0.490816424808 © 0.497919293873 © 0.463277414447 © 0.585101517174 © 0.732074178077 © 0.76453
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27
             HCanyon11R2 0.52855255543 0.55774407831 0.555177188694 0.432763917311 0.429877059678 0.440567014981 0.41332040453 0.426696806769 0.398447088329 0.396059530935 0.433778641456 0.546155178322 0.730957367352
             HCanyon11R1 > 0.555250897098 > 0.579991048797 > 0.575126874355 > 0.453486254954 > 0.4588780311 > 0.456712334902 > 0.419232496891 > 0.446896791255 > 0.430325765526 > 0.428966840449 > 0.431167398777 > 0.579943394066 > 0.732067246808
             HCanyon6R2 > 0.568527068157 > 0.58513246508 > 0.58513246508 > 0.430174126838 > 0.419369519662 > 0.42708499988 > 0.416828113391 > 0.426928785146 > 0.410839210322 > 0.422526407071 > 0.577408501553 > 0.724983493714 > 0.74944501553 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.74983493714 > 0.7498
             HCanyon6R3 0.566346578975 0.587780110737 0.586940661236 0.438634245182 0.425883025257 0.449519180577 0.424862337935 0.447100684715 0.425434475646 0.426218627557 0.424693270252 0.575001288601 0.727225744269 0.74848
             HCanyon6R1 > 0.583972679946 > 0.586778207344 > 0.581534515565 > 0.424307243199 > 0.421765941119 > 0.415236907762 > 0.428454635151 > 0.428113957425 > 0.406954252133 > 0.422536839493 > 0.577320334932 > 0.715559691738 > 0.715559691738 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 0.74188 > 
             HCanyon5R1 ≥ 0.558910457622 ≥ 0.57470972671 ≥ 0.562821643814 ≥ 0.440681773256 ≥ 0.451596106791 ≥ 0.444216261284 ≥ 0.424754580111 ≥ 0.435763316753 ≥ 0.417737787339 ≥ 0.416631599644 ≥ 0.455877139948 ≥ 0.563966325588 ≥ 0.708246555272 ≥ 0.73631
                                                                                                                            0.584250873735 0.450336948189 0.426574240559 0.448524323812 0.439745925494 0.440643510478 0.417613041188 0.413563495656 0.464820696561 0.585818294798 0.710049190032
             HCanyon5R2 0.577951660858 0.593568671618 0.596389572645 0.422545765978 0.409515246412 0.434403209926 0.429247944328 0.453870629905 0.431590973836 0.41366014112 0.436175614058 0.596389572645 0.4717174395032 0.73322
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             HCanyon4R3 0.624113459554 0.653406187405 0.649892943176 0.438848993112 0.452700670776 0.45666604112 0.506388612937 0.493725468949 0.479954328128 0.462327913958 0.510888415471 0.640846248971 0.676842167997
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             HCanyon12R2 \ge 0.552892298156 \ge 0.560516044793 \ge 0.549257756132 \ge 0.504271040435 \ge 0.504749255647 \ge 0.517681811493 \ge 0.489487879426 \ge 0.489487879426 \ge 0.485996535935 \ge 0.465436661211 \ge 0.529531879489 \ge 0.731659602418 \ge 0.73165
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             HCanyon8R3 © 0.549015567252 © 0.573444281355 © 0.580500957664 © 0.446205572204 © 0.446999609932 © 0.453171155433 © 0.4327591563
                                                                                                                                                                                                                                                                                                                                           0.535707795107 + 0.569114464296 + 0.574510728774 + 0.46528819939 + 0.452053418068 + 0.460087502347 + 0.379587194176 + 0.458489263366 + 0.421181481291 + 0.440297005744 + 0.366881097176 + 0.571016550292 + 0.729475827592 + 0.75446
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                                                                                                                                                                                                                                                                                                           0.538798221769 0.543866219051 0.557970880727 0.543811509839 0.541537645813 0.56301479339 0.486181550953 0.53366160907 0.52362238711 0.535021530589 0.480837812931 0.481956348268 0.773410694328 0.773410694328
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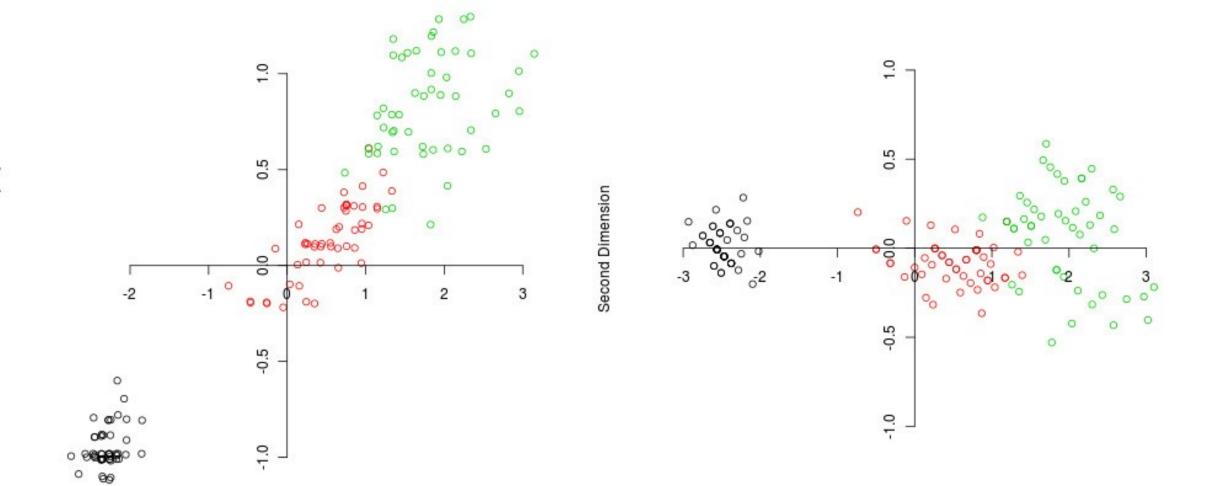
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Principal Coordinates Analysis: Example



PCA and PCoA explained





Principal Coordinates Analysis: Example

