R:BioC III, COSMO

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What is COSMO?

It is a package used to find motifs in a set of unaligned sequences. It allows the search to be supervised by specifying a set of constraints, such as motif length, number of sequence apparitions, forward or reverse strand.

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Methods - Probabilistic Models

There are 3 main methods and they are based on the number of occurrences of the motif in the sequence.

- OOPS
  This model assumes One Occurrence Per Sequence.
- ZOOPS
  This model assumes Zero or One Occurrence per Sequence.
- TCM
  This model assumes a Two Component Mixture, meaning one who describes the distribution of nucleotides in the motif, and the other in the background (More Than One Occurrence).

Constraints - Motif Intervals

One Motif can be divided into separated intervals each corresponding to a distinct set of constraints. That is, each section of the motif can be evaluated differently.

- Fixed
  Designates a fixed length for the interval.
- Proportionate
  Designates a proportional length for the interval.
- Remainder
  Allocates whatever sequence is left after allocating with the first methods.

Constraints - Constraints on the Information Content

Information Content is a measure of the tolerance for substitutions in a specific position of the sequence. It ranges from 0 to 2, and it is given in bits where:

- 0
  All nucleotides occur with equal probability
- 2
  Only a single nucleotide can occur.
- 1
  Neither all nor one.

Remember: conserved regions are rich in Information, variable regions are poor.

Constraints - Misc

- Palindromic Intervals
  COSMO allows the user to specify two intervals that are Palindromic respectively (homodimeric TFs).
- Sub-motifs
  Allows defining motifs within motifs.
- Shape
  We may want to exclude Weight Matrices with contrasting values (extreme shape) in favor of others with more conservative values.
- Lower Bounds
  We may require a min.value for a specific variable, be it nucleotide frequency, AT content or GC content.

Where to Begin

- Select Order of the Background Markov Model.
- Define the width of the Motif.
- The Occurrence Model.
- Extra Constraints.

Software Implementation I

First we load the package into the local library.

```
> library(cosmo)
```

Thus it is loaded.

Simulating Sequences I

The GREAT function rseq() allows the user to generate random sequences.

```
> args(rseq)

function (numSeqs, seqLength, rate, pwm, transMats, model = "ZOOPS",
    posOnly = FALSE)
NULL
```

It generates 3 objects:

- seqs
  List of Generated Sequences
- motifs
  An Align object summarizing the position of the inserted motif occurrences.
- empPWM
  A pwm object obtained by aligning the inserted motifs.

Example of a PWM for a motif of width 8

```
> data(motifPWM)
> motifPWM
```

```
     1   2   3   4   5   6   7   8
A 0.0 0.0 0.0 0.3 0.2 0.0 0.0 0.0
C 0.8 0.2 0.8 0.3 0.4 0.2 0.8 0.2
G 0.2 0.8 0.2 0.4 0.3 0.8 0.2 0.8
T 0.0 0.0 0.0 0.0 0.1 0.0 0.0 0.0
```

Example of the motif object

```
> data(transMats)
> simSeqs <- rseq(20, 100, 1, motifPWM, transMats, "ZOOPS")
> simSeqs$motifs
```

	seq	pos	orient	motif	prob
1	Seq1	72	-1	CCCGGGGC	1
2	Seq2	42	-1	CCGCGGCC	1
3	Seq3	78	-1	GGCCCGCG	1
4	Seq4	20	1	GGCACGCG	1
5	Seq5	69	-1	CGCAGGGG	1
6	Seq6	20	1	CGCCGGCG	1
7	Seq7	1	-1	CCCCCGCG	1
8	Seq8	11	1	CGCAGGCG	1
9	Seq9	43	-1	GGCCAGCG	1
10	Seq10	92	1	GGCAGGGG	1
11	Seq11	83	1	CGCCAGCC	1
12	Seq12	80	-1	CGCACGCC	1
13	Seq13	60	1	CGCGGGGG	1
14	Seq14	75	1	CCGGTGCG	1
15	Seq15	91	1	CGCACCCG	1
16	Seq16	12	1	CGGAAGCG	1
17	Seq17	56	1	CGGACGGG	1
18	Seq18	71	-1	CGCGTCCG	1
19	Seq19	38	-1	CCGGCGCC	1
20	Seq20	58	1	CGCGGGCG	1

Constructing Constraint Sets I

A constraintSet object is initially constructed using the function makeConSet()

```
> args(makeConSet)

function (numInt, type, length, descrip = "Constraint Set")
NULL
```

Example of a Constraint Set consisting of a 3bp interval, a variable.length interval, and another 3bp interval:

```
> conSet1 <- makeConSet(numInt = 3, type = c("B", "V", "B"), length = c(3, NA,
+     3))
> conSet1
```

```
@ ConstraintSet: 1
>IntervalSetup
Length: 3 bp
Length: variable
Length: 3 bp
```

Example of a List of Constraints that can be added to the previous Constraint Set

```
> boundCon1 <- makeBoundCon(lower = 1, upper = 2)
> boundCon2 <- makeBoundCon(lower = 0, upper = 1)
> palCon1 <- makePalCon(int1 = 1, int2 = 3, errBnd = 0.05)
> constraint <- list(boundCon1, boundCon2, palCon1)
> int <- list(1, 2, NA)
> conSet1 <- addCon(conSet = conSet1, constraint = constraint, int = int)
> conSet1
```

```
@ ConstraintSet: 1
>IntervalSetup
Length: 3 bp
Length: variable
Length: 3 bp
>IcBounds
Interval: 1
Bounds: 1 to 2
>IcBounds
Interval: 2
Bounds: 0 to 1
>Pal
Intervals: 1 and 3
ErrorTol: 0.05
```

Example of a List of Constraints that searches for submotifs

```
> conSet2 <- makeConSet(numInt = 1, type = "V", length = NA)
> subCon1 <- makeSubMotifCon(submotif = "TATA", minfreq = 0.9)
> conSet2 <- addCon(conSet = conSet2, constraint = subCon1, int = NA)
> conSet2

@ ConstraintSet: 1
>IntervalSetup
Length: variable
>SubMotif
Motif: TATA
MinFreq: 0.9
```

Finally, The COSMO Function I

The COSMO function carries out the supervision of motif detection. The arguments are:

```
> args(cosmo)
```

```
function (seqs = "browse", constraints = "None", minW = 6, maxW = 15,
    models = "ZOOPS", revComp = TRUE, minSites = NULL, maxSites = NULL,
    starts = 5, approx = "over", cutFac = 5, wCrit = "bic", wFold = 5,
    wTrunc = 100, modCrit = "lik", modFold = 5, modTrunc = 100,
    conCrit = "likCV", conFold = 5, conTrunc = 90, intCrit = "lik",
    intFold = 5, intTrunc = 100, maxIntensity = FALSE, lstarts = FALSE,
    backSeqs = NULL, backFold = 5, bfile = NULL, transMat = NULL,
    order = NULL, maxOrder = 6, silent = FALSE)
NULL
```

This function's output is an object of the class cosmo, it holds the following slots:

```
> slotNames("cosmo")

 [1] "seqs"       "pwm"        "back"       "tmat"       "cand"       "cons"
 [8] "motifs"     "probs"      "objectCall"
```

Example of the cosmo function I

```
> seqFile <- system.file("Exfiles/seq.fasta", package = "cosmo")
> res <- cosmo(seqs = seqFile, constraints = list(conSet1, conSet2), minW = 7,
+     maxW = 8, models = c("OOPS", "TCM"))

cvOrder: Order of background Markov model estimated as order = 0 by CV

initConSets: constraint set 1
initConSets: NumBasePairs for interval 1: 3
initConSets: Interval 2 is variable length
initConSets: NumBasePairs for interval 3: 3
initConSets: constraint set 2
initConSets: Interval 1 is variable length

addConstraints: constraint set 1
addBoundCon: Added bound constraint to conSet 1 interval 1
addBoundCon: Added bound constraint to conSet 1 interval 2
addPalCon: Added palindromic constraint to conSet 1
addConstraints: constraint set 2
addSubCon: Added submotif constraint to conSet 2


eGetStart: Extracting starting values from sequence 1/10
eGetStart: Extracting starting values from sequence 2/10
eGetStart: Extracting starting values from sequence 3/10
eGetStart: Extracting starting values from sequence 4/10
```

Example of the cosmo function II

```
eGetStart: Extracting starting values from sequence 5/10
eGetStart: Extracting starting values from sequence 6/10
eGetStart: Extracting starting values from sequence 7/10
eGetStart: Extracting starting values from sequence 8/10
eGetStart: Extracting starting values from sequence 9/10
eGetStart: Extracting starting values from sequence 10/10

fit: mType =  OOPS conSet = 1 width = 7 nSitesNum = 1/1 starting value = 1/5
fit: mType =  OOPS conSet = 1 width = 7 nSitesNum = 1/1 starting value = 2/5
fit: mType =  OOPS conSet = 1 width = 7 nSitesNum = 1/1 starting value = 3/5
fit: mType =  OOPS conSet = 1 width = 7 nSitesNum = 1/1 starting value = 4/5
fit: mType =  OOPS conSet = 1 width = 7 nSitesNum = 1/1 starting value = 5/5
fit: mType =  OOPS conSet = 1 width = 8 nSitesNum = 1/1 starting value = 1/5
fit: mType =  OOPS conSet = 1 width = 8 nSitesNum = 1/1 starting value = 2/5
fit: mType =  OOPS conSet = 1 width = 8 nSitesNum = 1/1 starting value = 3/5
fit: mType =  OOPS conSet = 1 width = 8 nSitesNum = 1/1 starting value = 4/5
fit: mType =  OOPS conSet = 1 width = 8 nSitesNum = 1/1 starting value = 5/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 1/6 starting value = 1/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 1/6 starting value = 2/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 1/6 starting value = 3/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 1/6 starting value = 4/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 1/6 starting value = 5/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 2/6 starting value = 1/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 2/6 starting value = 2/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 2/6 starting value = 3/5
```

Example of the cosmo function III

```
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 2/6 starting value = 4/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 2/6 starting value = 5/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 3/6 starting value = 1/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 3/6 starting value = 2/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 3/6 starting value = 3/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 3/6 starting value = 4/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 3/6 starting value = 5/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 4/6 starting value = 1/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 4/6 starting value = 2/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 4/6 starting value = 3/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 4/6 starting value = 4/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 4/6 starting value = 5/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 5/6 starting value = 1/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 5/6 starting value = 2/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 5/6 starting value = 3/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 5/6 starting value = 4/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 5/6 starting value = 5/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 6/6 starting value = 1/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 6/6 starting value = 2/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 6/6 starting value = 3/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 6/6 starting value = 4/5
fit: mType =   TCM conSet = 1 width = 7 nSitesNum = 6/6 starting value = 5/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 1/6 starting value = 1/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 1/6 starting value = 2/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 1/6 starting value = 3/5
```

Example of the cosmo function IV

```
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 1/6 starting value = 4/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 1/6 starting value = 5/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 2/6 starting value = 1/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 2/6 starting value = 2/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 2/6 starting value = 3/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 2/6 starting value = 4/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 2/6 starting value = 5/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 3/6 starting value = 1/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 3/6 starting value = 2/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 3/6 starting value = 3/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 3/6 starting value = 4/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 3/6 starting value = 5/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 4/6 starting value = 1/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 4/6 starting value = 2/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 4/6 starting value = 3/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 4/6 starting value = 4/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 4/6 starting value = 5/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 5/6 starting value = 1/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 5/6 starting value = 2/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 5/6 starting value = 3/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 5/6 starting value = 4/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 5/6 starting value = 5/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 6/6 starting value = 1/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 6/6 starting value = 2/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 6/6 starting value = 3/5
```

Example of the cosmo function V

```
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 6/6 starting value = 4/5
fit: mType =   TCM conSet = 1 width = 8 nSitesNum = 6/6 starting value = 5/5
fit: mType =  OOPS conSet = 1 width = 8 nSitesNum = 1/1 starting value = 4/5
fit: mType =  OOPS conSet = 1 width = 8 nSitesNum = 1/1 starting value = 4/5
fit: mType =  OOPS conSet = 1 width = 8 nSitesNum = 1/1 starting value = 4/5
fit: mType =  OOPS conSet = 1 width = 8 nSitesNum = 1/1 starting value = 4/5
fit: mType =  OOPS conSet = 1 width = 8 nSitesNum = 1/1 starting value = 4/5
fit: mType =  OOPS conSet = 2 width = 7 nSitesNum = 1/1 starting value = 1/5
fit: mType =  OOPS conSet = 2 width = 7 nSitesNum = 1/1 starting value = 2/5
fit: mType =  OOPS conSet = 2 width = 7 nSitesNum = 1/1 starting value = 3/5
fit: mType =  OOPS conSet = 2 width = 7 nSitesNum = 1/1 starting value = 4/5
fit: mType =  OOPS conSet = 2 width = 7 nSitesNum = 1/1 starting value = 5/5
fit: mType =  OOPS conSet = 2 width = 8 nSitesNum = 1/1 starting value = 1/5
fit: mType =  OOPS conSet = 2 width = 8 nSitesNum = 1/1 starting value = 2/5
fit: mType =  OOPS conSet = 2 width = 8 nSitesNum = 1/1 starting value = 3/5
fit: mType =  OOPS conSet = 2 width = 8 nSitesNum = 1/1 starting value = 4/5
fit: mType =  OOPS conSet = 2 width = 8 nSitesNum = 1/1 starting value = 5/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 1/6 starting value = 1/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 1/6 starting value = 2/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 1/6 starting value = 3/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 1/6 starting value = 4/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 1/6 starting value = 5/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 2/6 starting value = 1/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 2/6 starting value = 2/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 2/6 starting value = 3/5
```

Example of the cosmo function VI

```
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 2/6 starting value = 4/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 2/6 starting value = 5/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 3/6 starting value = 1/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 3/6 starting value = 2/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 3/6 starting value = 3/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 3/6 starting value = 4/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 3/6 starting value = 5/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 4/6 starting value = 1/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 4/6 starting value = 2/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 4/6 starting value = 3/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 4/6 starting value = 4/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 4/6 starting value = 5/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 5/6 starting value = 1/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 5/6 starting value = 2/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 5/6 starting value = 3/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 5/6 starting value = 4/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 5/6 starting value = 5/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 6/6 starting value = 1/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 6/6 starting value = 2/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 6/6 starting value = 3/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 6/6 starting value = 4/5
fit: mType =   TCM conSet = 2 width = 7 nSitesNum = 6/6 starting value = 5/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 1/6 starting value = 1/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 1/6 starting value = 2/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 1/6 starting value = 3/5
```

Example of the cosmo function VII

```
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 1/6 starting value = 4/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 1/6 starting value = 5/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 2/6 starting value = 1/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 2/6 starting value = 2/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 2/6 starting value = 3/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 2/6 starting value = 4/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 2/6 starting value = 5/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 3/6 starting value = 1/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 3/6 starting value = 2/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 3/6 starting value = 3/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 3/6 starting value = 4/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 3/6 starting value = 5/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 4/6 starting value = 1/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 4/6 starting value = 2/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 4/6 starting value = 3/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 4/6 starting value = 4/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 4/6 starting value = 5/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 5/6 starting value = 1/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 5/6 starting value = 2/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 5/6 starting value = 3/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 5/6 starting value = 4/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 5/6 starting value = 5/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 6/6 starting value = 1/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 6/6 starting value = 2/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 6/6 starting value = 3/5
```

Example of the cosmo function VIII

```
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 6/6 starting value = 4/5
fit: mType =   TCM conSet = 2 width = 8 nSitesNum = 6/6 starting value = 5/5
fit: mType =  OOPS conSet = 2 width = 7 nSitesNum = 1/1 starting value = 1/5
fit: mType =  OOPS conSet = 2 width = 7 nSitesNum = 1/1 starting value = 1/5
fit: mType =  OOPS conSet = 2 width = 7 nSitesNum = 1/1 starting value = 1/5
fit: mType =  OOPS conSet = 2 width = 7 nSitesNum = 1/1 starting value = 1/5
fit: mType =  OOPS conSet = 2 width = 7 nSitesNum = 1/1 starting value = 1/5
finalModel: fitting model for width 8 modType OOPS and conSet 1

finalModel: startNum 3 and nSitesNum 0

fit: mType =  OOPS conSet = 1 width = 8 nSitesNum = 1/1 starting value = 4/5
```

```
> print(res)
```

```
       1      2      3      4      5      6      7      8
A 0.0000 0.0000 0.0000 0.1592 0.1933 0.0000 0.0000 0.0000
C 0.8164 0.2294 0.7677 0.3530 0.2984 0.1823 0.8206 0.2336
G 0.1836 0.7706 0.2323 0.4878 0.1609 0.8177 0.1794 0.7664
T 0.0000 0.0000 0.0000 0.0000 0.3475 0.0000 0.0000 0.0000
```

The summary() function will display a summary of the object, while the print only outputs the PWM.

The seqs slot.

```
> res@seqs
```

```
[[1]]
[[1]]$seq
[1] "GCTTCTGGTTCTATTGAAAAAATTCAGGTGGGGATGTCCAGGTGAAAAATATTTTTAGAATAGAAAAACGCCAG

[[1]]$desc
[1] "Seq1"


[[2]]
[[2]]$seq
[1] "GATTGTGTTTAAAATAGATGTTTAAAGTAGCTCTCGCGCGCGCACTTTAGATGAATTTAAATGATATACATTGA

[[2]]$desc
[1] "Seq2"


[[3]]
[[3]]$seq
[1] "TAAGGGATCCTGTGAGGTTAAAGTTTATTGCGGTAATATACTTAAATACGACTATAATTTCTTAATAGCACTAT

[[3]]$desc
[1] "Seq3"
```

```
[[4]]
[[4]]$seq
[1] "CATCTATATATTTTCCGGAGCGCATTCTTTTTCCCAAGTAAGATAATTGCTTATCTCTAAATTTCGAAAAAGGT

[[4]]$desc
[1] "Seq4"


[[5]]
[[5]]$seq
[1] "GGTGTCCCTAAATGTGGAGATAACGGAGAGTTCTCAAGTTTAATCGTATGTCAGATCTTATAAAACGATGCAAC

[[5]]$desc
[1] "Seq5"


[[6]]
[[6]]$seq
[1] "TAATCAACTGTCATAGTTCCCCCATGGGTCTATTATGTTATGTATATGAGACTCATTTTTTAACCTCATAAAGA

[[6]]$desc
[1] "Seq6"


[[7]]
```

```
[[7]]$seq
[1] "CTCACATAAAATGTATGCTTTTTTCTCACTTTTAAAAATTTTGATCTATAAAAAGTCTATACACCTTTCGGGCG

[[7]]$desc
[1] "Seq7"


[[8]]
[[8]]$seq
[1] "GAAAGATAAGGTCATTTTTTCTTGGGGCTGCCTTACCAGATTTTATGATTCTGAAAAAAAAAATGTTATGATGT

[[8]]$desc
[1] "Seq8"


[[9]]
[[9]]$seq
[1] "TTTACCCGCCCGCGTATTCACGTGGCAACCAGTTATCTCAATAGGAGTTCTTGGACCATTTTAGATGATTATCA

[[9]]$desc
[1] "Seq9"


[[10]]
[[10]]$seq
[1] "AACGATAAAAAACGGCACGCGTCTTATCTGATAAGCGTTATTTTTCCTCATTACTAAACCCCTACTTTGATCCC
```

```
[[10]]$desc
[1] "Seq10"
```

The pwm slot.

```
> res@pwm
```

```
       1      2      3      4      5      6      7      8
A 0.0000 0.0000 0.0000 0.1592 0.1933 0.0000 0.0000 0.0000
C 0.8164 0.2294 0.7677 0.3530 0.2984 0.1823 0.8206 0.2336
G 0.1836 0.7706 0.2323 0.4878 0.1609 0.8177 0.1794 0.7664
T 0.0000 0.0000 0.0000 0.0000 0.3475 0.0000 0.0000 0.0000
```

The back slot.

```
> res@back
```

```
  order          klDiv
1     0  1.351885e+02
2     1  1.352459e+02
3     2  1.367819e+02
4     3 1.797693e+308
5     4           Inf
6     5           Inf
7     6           Inf
```

The tmat slot.

```
> res@tmat
```

```
$order0
     A    C     G     T
-- 0.3 0.18 0.184 0.336
```

The cand slot.

```
> res@cand
```

	conSet	model	width	wCrit	modCrit	conCrit
1	1	OOPS	7	2705.699	NA	NA
2	1	OOPS	8	2686.247	-1315.493	133.2438
3	1	TCM	7	2720.743	NA	NA
4	1	TCM	8	2706.129	-1324.282	NA
5	2	OOPS	7	2731.405	-1341.525	137.1235
6	2	OOPS	8	2732.561	NA	NA
7	2	TCM	7	2736.401	-1342.872	NA
8	2	TCM	8	2737.127	NA	NA

The cons slot.

```
> res@cons
```

```
@ ConstraintSet: 1
>IntervalSetup
Length: 3 bp
Length: variable
Length: 3 bp
>IcBounds
Interval: 1
Bounds: 1 to 2
>IcBounds
Interval: 2
Bounds: 0 to 1
>Pal
Intervals: 1 and 3
ErrorTol: 0.05
```

The sel slot.

```
> res@sel
```

```
              choice  crit    critVal
Constraint         1 likCV   133.2438
Model           OOPS   lik -1315.4926
Width              8   bic  2686.2472
NumSites          10   lik -1315.4926
Markov Order       0 likCV   135.1885
```

The motifs slot.

```
> res@motifs
```

	seq	pos	orient	motif	prob
1	Seq8	25	1	GGGCTGCC	1.0000000
2	Seq6	21	1	CCCATGGG	1.0000000
3	Seq1	69	1	CGCCAGCG	1.0000000
4	Seq2	35	1	CGCGCGCG	0.9998825
5	Seq3	86	-1	CGGACGCG	0.9994560
6	Seq10	14	-1	GGCACGCG	0.9949939
7	Seq5	79	-1	GGCCGGCG	0.9729886
8	Seq4	15	1	CCGGAGCG	0.9269467
9	Seq7	69	-1	CGGGCGGG	0.9081801
10	Seq9	7	1	CGCCCGCG	0.9020890

The probs slot.

```
> res@probs
```

```
[[1]]
  [1] -5.754730e-34  2.283707e-47 -2.143658e-65  4.333443e-63  2.841212e-4
  [7] -5.207516e-65  5.099987e-79  3.848813e-78  4.847656e-64 -2.478874e-6
 [13]  3.506627e-97  1.362374e-80  1.809894e-79  1.396674e-79  1.452025e-9
 [19] -8.297952e-76 -8.956235e-63 -9.154292e-63  1.177008e-63  2.053809e-4
 [25]  1.986256e-17 -8.136162e-16 -8.797850e-32  8.371041e-48  4.502096e-4
 [31]  2.229496e-18 -7.778533e-33 -5.347024e-48 -6.342670e-48  1.600786e-4
 [37]  8.743032e-32 -9.173179e-47 -1.065984e-47 -7.548240e-62  1.309332e-6
 [43]  3.026058e-77  2.304534e-81  2.269018e-94 -5.478358e-94 7.022977e-10
 [49] -1.442002e-94 -2.525715e-95 -3.946677e-79 -9.576765e-81 -3.925720e-9
 [55]  1.773189e-94  8.219493e-64 -3.277729e-61 -1.804336e-78 -1.515533e-9
 [61]  1.525859e-80  1.539863e-65  1.427525e-49  7.581480e-51 -9.852261e-4
 [67] -2.840880e-46 -7.469524e-33  1.000000e+00  1.683884e-17  8.008812e-4
 [73] -4.261269e-47 -1.088235e-33  2.387649e-63 -1.136633e-79  3.427188e-9
 [79]  1.154552e-77  1.499458e-63 -8.249846e-94  2.930969e-94 -4.191207e-6
 [85] -4.387875e-49 -1.095972e-63  1.056509e-62 -1.179413e-63  1.941680e-4
 [91]  5.973907e-34  1.402485e-18 -1.183713e-30  0.000000e+00  0.000000e+0
 [97]  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00

[[2]]
  [1] -4.577704e-66  3.885184e-79 -1.714449e-82  6.639297e-79 -1.160938e-6
  [7] -1.119469e-96  7.716554e-95  5.099860e-96  1.115308e-79 -1.087913e-7
 [13] -4.482228e-79  4.256798e-79  1.506394e-62 -1.257769e-78 -4.651935e-8
```

```
 [19]  -5.513078e-81  -4.418480e-82   2.257615e-79   4.730450e-80   1.926334e-7
 [25]  -1.789060e-63  -1.729993e-48   1.368537e-62   2.963933e-49  -6.631692e-3
 [31]  -1.183372e-17   2.447578e-34   6.889449e-17   1.026923e-18   9.998825e-0
 [37]  -2.211719e-15   3.578503e-20   7.242036e-31   1.753009e-33   1.259833e-4
 [43]  -1.421887e-49  -9.669163e-64   1.066329e-79   2.220708e-80   1.165106e-7
 [49]  -4.411723e-79   6.908711e-80   8.507897e-80   6.678204e-79  -9.378696e-8
 [55] 1.891856e-111   1.590985e-80   2.331571e-80   5.157953e-78  -5.222158e-9
 [61]  -3.215990e-79   2.484660e-79  -1.411335e-64  -2.781729e-95   6.137749e-9
 [67]  -4.752481e-64  -4.027390e-48  -6.353407e-50   1.367666e-66   1.005644e-4
 [73]   3.930596e-36  -9.131321e-48  -7.354285e-64   1.547053e-63   1.544531e-6
 [79]   4.821571e-64  -2.513155e-80  -1.099102e-81  -4.919881e-78  -1.512917e-6
 [85]   4.496674e-82   2.575010e-65   4.215787e-49   1.971569e-34  -1.275732e-4
 [91]  -2.045772e-31  -3.413399e-17  -6.102077e-17   0.000000e+00   0.000000e+0
 [97]   0.000000e+00   0.000000e+00   0.000000e+00   0.000000e+00

[[3]]
  [1]  2.025759e-76 -3.135515e-63  6.419908e-33  1.161499e-16 -5.383238e-33  5.
  [7] -3.299839e-47 -5.886224e-48  5.834796e-33 -3.953585e-34  1.368811e-45  6.
 [13]  2.852490e-77 -1.093887e-63 -2.489930e-62 -5.995509e-65  1.216977e-64  7.
 [19]  5.196251e-92 -1.079469e-91 -3.198694e-79 -1.671858e-79  2.747884e-80  3.
 [25] -6.844371e-49 -1.598595e-49 -1.490842e-62  2.893765e-63  4.513647e-62  6.
 [31] -1.171565e-63  2.523241e-63 -1.462857e-79  1.888382e-94 -1.503916e-78  3.
 [37] -5.358546e-94 -1.925410e-92 -1.256969e-79  6.711656e-95  3.119592e-81  2.
 [43]  5.661564e-63 -1.368331e-76 -1.895581e-62 -9.768797e-78  2.007014e-63 -6.
 [49] -6.543502e-63 -1.214472e-78  1.920786e-79  1.174848e-93  9.555104e-93 -1.
 [55] -4.572480e-80 -1.495069e-79 -1.170043e-92  1.267379e-94 -6.327525e-82  3.
```

```
 [61]  6.091389e-65  3.216453e-64 -8.609712e-78 -4.150581e-63 -2.504084e-77  4.
 [67] -1.082189e-61 -4.364960e-64 -3.847214e-64  2.556616e-63 -6.585476e-79  2.
 [73] -1.819920e-62  3.280628e-48 -6.871103e-32  4.865679e-46 -7.686104e-63 -6.
 [79]  5.085882e-18 -1.050636e-16 -1.441037e-18 -2.014296e-46  3.807657e-48 -3.
 [85]  5.440269e-04 -9.994560e-01 -7.397426e-18  1.113228e-30 -1.211406e-46  2.
 [91]  9.609711e-34  2.708673e-46 -1.143682e-48  0.000000e+00  0.000000e+00  0.
 [97]  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00

[[4]]
  [1] -1.455964e-78  4.792351e-93  5.808679e-79  1.048968e-92  2.026910e-9
  [7]  8.737732e-92 -3.333706e-78 -1.463106e-64 -4.677184e-47 -3.716426e-4
 [13]  2.073569e-46  1.174171e-31  9.269467e-01 -7.305333e-02 -1.759016e-2
 [19]  8.017550e-61  4.407194e-33  2.061538e-29 -9.065718e-50 -2.740343e-7
 [25] -1.027463e-80 -9.845661e-66 -6.048468e-49 -5.126971e-50 -5.542260e-6
 [31]  4.204780e-62  2.712001e-45  1.011497e-32 -1.321233e-61 -6.281447e-6
 [37]  1.165288e-62 -3.294061e-78  2.361576e-93 -1.830084e-78  1.141084e-9
 [43] -2.829717e-62 -1.020849e-63 -3.448934e-78 -1.879735e-91  4.434730e-7
 [49]  3.369897e-62  3.375016e-49 -4.305494e-79  1.309502e-78 -7.926234e-7
 [55]  8.692626e-78  4.827472e-77  5.129610e-77  8.260130e-78 -7.217908e-6
 [61] -2.925698e-76  2.451755e-94  1.749868e-78  4.440177e-64  4.535797e-4
 [67]  1.086920e-62 -3.691795e-61 -8.254530e-60 -1.337739e-45 -1.015518e-4
 [73]  1.267905e-48  1.299053e-48  3.367000e-48  1.663261e-78  1.285781e-7
 [79] -8.111376e-46 -5.358468e-64 -8.332792e-77 -8.057973e-61 -1.510930e-4
 [85]  1.897475e-63  5.884037e-62 -8.063310e-78  9.847185e-65  4.763875e-6
 [91]  1.399751e-77  6.388866e-93  1.026360e-77  0.000000e+00  0.000000e+0
 [97]  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
```

```
[[5]]
  [1]   4.954261e-18  -1.734738e-34   5.099949e-63  -4.705729e-63   1.814148e-6
  [7]   1.728961e-49   9.891289e-63   1.057553e-62  -1.548357e-61  -3.394100e-6
 [13]  -3.507753e-63   8.470856e-48   1.888385e-63   3.128181e-64  -2.056220e-5
 [19]   2.230380e-35  -2.167221e-60   1.279139e-62  -1.166317e-60   1.021795e-3
 [25]   3.104534e-46  -2.260009e-49   5.539870e-61  -2.216288e-35  -2.611553e-6
 [31]  -4.954131e-65   3.441120e-62   7.179667e-47   2.057041e-76  -8.123785e-7
 [37]  -1.939150e-79   2.054877e-81   3.273314e-63   2.955860e-62  -4.238049e-7
 [43]  -4.956674e-63   9.550820e-62   3.540043e-33  -1.357163e-62   1.085515e-6
 [49]   3.584310e-61  -1.156635e-49   3.754564e-60   8.760817e-48  -9.818352e-7
 [55]  -7.043887e-78   7.267964e-95  -1.039286e-79 -2.346240e-110   1.937546e-8
 [61]   1.232947e-64  -3.666261e-77  -1.805663e-77   3.823924e-49  -1.866315e-3
 [67]  -5.908692e-65   3.481794e-63   8.736968e-46  -9.125518e-63   2.762475e-6
 [73]  -1.895309e-47  -1.192150e-33   6.146703e-47   5.543795e-32  -1.392723e-1
 [79]  -9.729886e-01  -8.957088e-17  -8.192056e-32  -1.141890e-47   3.243904e-3
 [85]   2.823799e-46   3.233394e-78   8.894972e-93  -8.985554e-64  -4.564769e-6
 [91]  -9.575876e-82   1.210038e-62   2.519854e-33   0.000000e+00   0.000000e+0
 [97]   0.000000e+00   0.000000e+00   0.000000e+00   0.000000e+00

[[6]]
  [1] -2.564771e-79  1.174616e-77  1.295834e-48  5.287596e-60  5.082979e-47 -5.
  [7]  2.111728e-62 -7.662338e-63  1.590961e-61  3.732032e-47  2.337861e-75 -3.
 [13] -3.232839e-61 -9.549533e-34 -2.141795e-30 -8.042898e-33  4.362649e-46  1.
 [19]  3.432631e-31  5.350853e-16  1.000000e+00 -3.875008e-32 -2.645892e-47  5.
 [25]  1.739163e-46 -2.132891e-48  1.268883e-61 -4.428536e-78  2.814142e-76 -7.
```

```
 [31]  7.525036e-92  1.224413e-77 -2.826463e-93  3.677431e-91 -4.520025e-63  9.
 [37] -4.480878e-63 -5.514661e-95  1.801755e-93  2.989115e-93  4.449625e-62 -8.
 [43]  1.274200e-62 -7.778331e-76  1.147637e-62 -5.646284e-62  3.631473e-46 -7.
 [49]  2.273173e-61 -6.314483e-64  3.906131e-77  6.852582e-61 -4.071988e-80 -1.
 [55] -2.706495e-92 -1.445323e-94 -2.395567e-81  1.717646e-78  2.744904e-61  1.
 [61] -4.516100e-76  7.833770e-62 -1.724940e-60  1.021404e-63 -1.419289e-62  6.
 [67]  4.903606e-65  4.609724e-80  5.909710e-78  1.360555e-77  2.522316e-62 -9.
 [73]  4.931035e-47 -6.592436e-47 -1.489038e-46  3.099576e-61  4.709029e-60 -2.
 [79]  2.743524e-61 -1.413446e-48  6.766422e-63  2.295985e-32 -8.588289e-64  7.
 [85] -5.578696e-76  1.142338e-45 -8.820926e-32 -5.985963e-63  6.568534e-78  2.
 [91]  1.529552e-62 -4.447775e-60 -2.057467e-63  0.000000e+00  0.000000e+00  0.
 [97]  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00

[[7]]
  [1] -8.410190e-63  1.806567e-78 -5.622446e-63 -1.408403e-92  3.261397e-7
  [7]  6.251330e-77 -4.653498e-76 -4.658197e-93 -2.260469e-78 -1.155419e-6
 [13] -2.964374e-65  1.892585e-91  7.426943e-78 -4.163260e-65 -3.738463e-6
 [19] -3.763287e-81 -9.638844e-67 -1.235918e-78  3.245062e-64 -7.160513e-6
 [25]  1.281642e-61  1.337776e-75 -7.896077e-63 -1.181696e-77 -7.536380e-8
 [31]  6.608164e-96  4.425393e-93  1.367358e-92  1.288106e-93  4.135919e-9
 [37] -4.567091e-77 -2.409037e-79 -1.008242e-81  3.255037e-76  3.474773e-6
 [43] -1.149057e-79 -2.636834e-92  8.097243e-80 -2.906954e-94  7.401144e-9
 [49]  1.450095e-77  6.454032e-65 -1.291409e-76 -2.015689e-76 -2.818569e-7
 [55]  8.008098e-65  1.077764e-63 -9.098285e-65  1.156874e-63  1.033640e-6
 [61]  5.569208e-77  8.330822e-48 -3.710093e-31 -8.417631e-19 -4.647471e-3
 [67]  1.041505e-30  6.448975e-17 -9.081801e-01 -9.181992e-02  2.410596e-1
```

```
 [73]   3.715385e-32  -1.010059e-31  -3.020335e-33  -1.926477e-63   2.368335e-7
 [79]   1.684649e-62   2.704209e-62  -2.310619e-76  -1.138323e-77   7.696765e-7
 [85]   2.509383e-76   2.450053e-77  -2.097347e-81  -8.222165e-79  -3.390780e-6
 [91]  -1.386428e-50  -1.498730e-63   2.222422e-77   0.000000e+00   0.000000e+0
 [97]   0.000000e+00   0.000000e+00   0.000000e+00   0.000000e+00

[[8]]
  [1] -3.967420e-77  1.803942e-94 -5.325595e-62 -7.034655e-61  2.517162e-47 -3.
  [7] -7.499835e-76  4.692681e-62 -4.411367e-62  5.123293e-61  2.269009e-61 -6.
 [13] -1.674372e-79 -2.154976e-78 -4.864722e-80 -4.101278e-81 -2.556969e-79  8.
 [19] -7.795013e-33 -9.958259e-33 -4.369979e-32  5.212727e-44  2.541738e-30  2.
 [25]  1.000000e+00 -1.621894e-16  2.669801e-46 -6.799432e-62  1.718603e-45 -7.
 [31] -1.157516e-46 -1.153568e-47 -2.176745e-77  7.859841e-60  1.361624e-61  3.
 [37]  3.422805e-61 -3.299373e-75 -5.591910e-80 -2.935587e-78  1.176786e-93  2.
 [43] -2.319911e-95  2.213757e-77  1.729191e-61 -4.391593e-48 -6.870024e-62 -2.
 [49] -2.929053e-78  1.828214e-78  9.551446e-65  4.814435e-78  2.222097e-80  8.
 [55]  8.373940e-96  8.373940e-96  1.400084e-93  2.886668e-79  1.765861e-77 -1.
 [61] -3.086264e-90  1.984037e-92 -6.800205e-63 -1.708126e-77  1.246022e-62 -3.
 [67]  1.008168e-75  6.736513e-62 -1.109974e-78  8.863921e-77 -1.643134e-78 -5.
 [73] -1.906574e-64 -4.305025e-65 -1.094638e-62 -2.458562e-64 -7.322928e-78  2.
 [79] -1.433994e-61  3.060559e-61 -1.451606e-62 -8.783683e-92  1.913305e-64  8.
 [85]  1.498144e-76 -1.259739e-90  4.092731e-91 -7.167029e-63  1.868216e-77 -7.
 [91] -3.670160e-95  1.631314e-91  5.318900e-77  0.000000e+00  0.000000e+00  0.
 [97]  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00

[[9]]
```

```
 [1]  6.676639e-49  6.109698e-49  5.007804e-32 -6.403333e-17  9.681414e-02  1.
 [7]  9.020890e-01  1.203590e-17 -5.061370e-32  1.119134e-47  1.269222e-46  1.
[13] -9.331270e-48 -2.431357e-51 -3.010442e-65  5.389848e-65  7.768933e-48  8.
[19]  4.202465e-18 -5.449127e-31 -4.909301e-48  1.228490e-50  7.580809e-33  2.
[25] -4.517689e-34  3.629265e-63  3.578610e-63 -8.923993e-62  1.688798e-62 -2.
[31]  1.909445e-78  2.172344e-51 -6.525104e-79 -1.977375e-80 -1.141657e-79  2.
[37]  1.312569e-49  6.657231e-49 -4.548337e-63 -8.775476e-63 -6.214087e-79  6.
[43] -4.660812e-48  1.670952e-46 -1.059248e-51 -6.068922e-63  4.436405e-50 -2.
[49] -4.622100e-51  1.185066e-49  3.954691e-49  3.504731e-47  9.276005e-63  4.
[55]  3.145906e-63 -3.799645e-64 -1.871650e-65 -4.035210e-79  5.613541e-94  3.
[61]  1.628667e-79  7.634191e-63 -5.506267e-79  2.490095e-81  9.720037e-80 -1.
[67] -2.204790e-79 -1.942305e-64 -1.036944e-81  1.142817e-77 -1.422488e-63  6.
[73] -2.283852e-49 -1.610864e-79  4.767289e-66  4.539925e-49 -5.269693e-48 -1.
[79] -7.733131e-77  7.815682e-65  1.173362e-47  2.992215e-50 -2.076828e-33 -5.
[85]  2.435220e-65 -6.508220e-78  1.141968e-63 -5.363050e-50  2.051597e-49 -4.
[91]  3.062946e-77 -6.791284e-48 -3.200178e-32  0.000000e+00  0.000000e+00  0.
[97]  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00

[[10]]
 [1]  2.700184e-80 -9.339385e-63 -2.353839e-78  2.321077e-82  3.128133e-97  6.
 [7]  5.987095e-65  2.707938e-50 -3.193566e-46 -1.131129e-59 -5.145942e-47 -2.
[13]  5.006075e-03 -9.949939e-01  1.879399e-32  3.365871e-32  9.101302e-47  1.
[19] -1.538178e-48  5.674907e-62 -6.099025e-51  8.464629e-77  1.755417e-49 -1.
[25]  3.684448e-77 -2.294789e-77  3.297437e-79  1.239376e-49  1.319291e-63  3.
[31] -7.089743e-63  8.822331e-76 -8.595828e-77  1.059700e-61 -1.466808e-51  1.
[37]  6.627833e-79 -7.651932e-97 -1.487660e-81 -1.296845e-63 -2.468112e-66 -2.
```

```
[43]  3.042905e-78  1.074440e-61 -9.018322e-66  1.773635e-64  5.110314e-49 -1.
[49] -3.465975e-79 -2.198382e-92  1.088932e-94  1.291799e-79  1.781029e-50  4.
[55]  6.261330e-48 -1.022152e-61 -6.748860e-61 -3.269287e-47  7.850041e-31  3.
[61]  2.072103e-62  3.552245e-63 -1.250694e-63 -4.364127e-64 -7.800941e-66  4.
[67]  2.775292e-33 -6.567959e-47 -1.452253e-63 -5.641481e-77  8.108483e-64  7.
[73]  5.907347e-34  1.917279e-47 -1.979074e-77 -1.106621e-92 -9.306231e-63 -4.
[79] -4.685201e-34 -3.112013e-50  6.081273e-61 -1.609918e-66  1.285898e-75  1.
[85] -1.292528e-63 -2.992505e-50 -1.524763e-64  2.381493e-79  5.984661e-65  9.
[91]  7.748642e-49 -2.921857e-60  3.376465e-50  0.000000e+00  0.000000e+00  0.
[97]  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
```

The objectCall slot.

```
> res@objectCall
```

```
cosmo(seqs = seqFile, constraints = list(conSet1, conSet2), minW = 7,
    maxW = 8, models = c("OOPS", "TCM"))
```

That is All

Have a Nice Day :) We would like to thank Amhed, without whom this presentation would have been left at the mercy of LaTeX' profusing, difusing and cofusing errors.