Bayesian Analysis of ChIP-chip
The BAC package

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Contents

I Licensing 2

II Introduction 2

III Loading the BAC Package 2

IV Detecting bound regions 3
Part I
Licensing

This software is distributed under the Artistic License 2.0. In addition, we would appreciate if you cite the following papers when using this software for publication.


Then if you use the ER data (part of it is included in this package), you should cite the following paper:

Carroll et al 2006 http://www.cell.com/content/article/abstract?uid=PIIS0092867405004538

Part II
Introduction

In our guide, we include example of codes that we hope will help you when using the BAC package. The codes are kept at the basic level for ease of understanding. Some of the options in the functions have been set by default. To learn more about the exact parameters and usage of each function, you may type help(FUNCTION_NAME) of the function of interest in R after the BAC package is loaded.

The common goal in analyzing this ChIP-chip data is to detect DNA-protein interactions from ChIP-chip experiments. As of now, the BAC package has mainly be tested with Affymetrix tiling array data. However, we expect it to work with other platforms (e.g. Agilent, Nimblegen, cDNA, etc.). In order to use the BAC package you will need both treatment (IP) and control conditions (e.g. Mock IP) with replicates under each condition. Note that BAC does not deal with normalization, so you will have to normalize your data before hands. For Affymetrix arrays, we refer you to the MATR package which contains efficient normalization procedures.
Part III
Loading the BAC Package

To load the BAC package in R, we type

```R
> library(BAC)
```

Part IV
Detecting bound regions

We first load the estrogen receptor data (Carroll et al. 2006).

```R
> data(ER)
```

then we calculate the (joint) posterior probabilities of enrichment based on 50 iterations for speed up, you should use more when you run the BAC function (see default parameters)

```R
> load("bac.rda")
```

where w=5 is the window size, see parameter description for more details. Now you can have a look at these posterior probabilities to see where enriched regions might be, see Figure 1.

```R
> plot(ER[, 1], BAConER$jointPP, pch = "+", xlab = "Genomic Position", + ylab = "Posterior probabilities")
```
Now regions can be called putative regions using the `CallRegions` function by applying a 0.5 threshold (other thresholds can be used)

```r
> ERregions <- CallRegions(ER[, 1], BAConER$jointPP, cutoff = 0.5,
+                          maxGap = 500)
```

Finally, once we are happy with the regions detected we can easily create a BED file, which can be read and visualize in the UCSC genome browser.

```r
> nRegions <- max(ERregions)
> BED <- matrix(0, nRegions, 4)
> for (i in 1:nRegions) {
+     BED[i, 2:3] <- range(ER[ERregions == i, 1])
+     BED[i, 4] <- max(BAConER$jointPP[ERregions == i]) * 1000
+ }
> BED <- data.frame(BED)
> BED[, 1] <- "chr21"
> names(BED) <- c("chrom", "chromStart", "chromEnd", "Score")
> print(BED)

chrom chromStart chromEnd Score
1 chr21 14600350 14600679 1000
2 chr21 15171823 15172238 1000
3 chr21 15299545 15299909 980
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