

GSReg: A Package for Gene Set Variability Analysis

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1 Introduction

The GSReg package allows to analyze pathways based on the variability of the expression of sets of genes that are targets of those pathways. Basing this set statistic on variability enables inference of dysregulated pathways in diseases, including notably cancers. The first set statistic for gene variability was in the work of Eddy and his colleagues (see [1]) which used a ranked based methodology called *DIRAC*. *DIRAC* calculates a measure of variability of the ordering of

the expression of genes in a pathway for specific phenotype. The basic idea behind *DIRAC* is to generate a template for the pair-wise comparisons of gene expressions of a pathway within a phenotype. *DIRAC* calculates a measure of the variability of the ordering within the phenotype, i.e. the expected distance of a sample from the phenotype and the template of the phenotype. In mathematical terms, if we denote two i.i.d. samples from the same phenotypes by X and X' and D Kendall- τ -distance on the specific pathways, then the EVA [?] statistic is $E(D(X, X'))$. It identifies significantly dysregulated pathways by estimating p-values from a permutation test. Eddy et al. found that more pathological phenotypes usually have more pathways with higher variability compared to less pathological phenotypes.

However, the permutation test in *DIRAC* is computationally intensive and reaching low p-values may be impractical since they require a huge number of permutations. Low p-values are required for multiple hypothesis correction. A similar measure of variability of the orderings of gene sets was proposed in [2]. This method approximates the p-value theoretically, without a permutation test. This method is based on Kendall- τ distance [3] and the theory of U-Statistics, thus we call this method Gene Set Expression Variation Analysis (or in short EVA). Specifically, Kendall- τ distance between two expression profiles counts the number of disagreeing pairwise comparisons between two profiles. The EVA measures the variability of the gene expression of pathway genes from a phenotype by calculating the expectation of Kendall- τ distance between two random samples from the phenotype. EVA then identifies if the variability is significantly different across two phenotypes. To approximate this p-value EVA applies a U-Statistic Theory approach.

The *GReg* package contains two following utilities:

1. Identifying the dysregulated pathways with *DIRAC* measure of variability. The significance is calculated using permutation test. This is the first time that *DIRAC* analysis has been implemented in *R*. It also is more adaptable to new datasets than the original Matlab code in [1].
2. Identifying the dysregulated pathways with *EVA* measure of variability. The significance is approximated through applying U-statistics theory. This is very time efficient and consistent with both *DIRAC* and applying permutation test on EVA.

2 Input Data

2.1 Data structure

In short, the *GReg* package requires the following data in the following format:

1. Gene Expression Data

- (a) The expression be in the form of a matrix where rows represent genes (or probes) and columns represent samples.
- (b) The expression matrix cannot have NAs.
- (c) The expression matrix rows must have names of genes or the probes.

2. Pathways

- (a) The list of pathways must contain character vectors. Only the elements of the vectors which appear in rownames of the expression matrix are considered for analysis.
- (b) The list of the pathways must have names for each vectors.

3. Phenotypes

- (a) A factor with binary levels.

We used the data provided in the `GSBenchMark` package to reproduce the results in Eddy et al. [1]. The `GSBenchMark` contains data for the pathways as well as the gene expression and phenotype data from twelve studies. We load the information about the pathways from `GSBenchMark`:

```
> library(GSBenchMark)
> data(diracpathways)
> class(diracpathways)

[1] "list"

> names(diracpathways)[1:5]

[1] "DEATHPATHWAY"          "TCAPOPTOSISPATHWAY" "CCR3PATHWAY"
[4] "NEUTROPHILPATHWAY"    "ALTERNATIVEPATHWAY"

> class(diracpathways[[1]])

[1] "character"
```

AS mentioned `GSReg` package requires the information of the pathways to be as a list of character vectors. Also, `GSReg` requires the pathways to have names. The variable `diracpathways` contains gene pathways. It is a list. Each element represents a pathway with its name. Each elements contains a list of characters which represent the genes in the pathway. e.g. `diracpathways[["DEATHPATHWAY"]]`

Now, we load the datasets' names:

```
> data(GSBenchMarkDatasets)
> print(GSBenchMark.Dataset.names)
```

```
[1] "leukemia_GSEA"      "marfan_GDS2960"      "melanoma_GDS2735"
[4] "parkinsons_GDS2519" "prostate_GDS2545_m_nf" "prostate_GDS2545_m_p"
[7] "prostate_GDS2545_p_nf" "sarcoma_data"        "squamous_GDS2520"
[10] "breast_GDS807"      "bipolar_GDS2190"
```

The remaining examples in this vignette rely on one of the datasets, i.e. “squamous GDS2520.” Similar analyses may be reproduced for other datasets by selecting a different element of “GS-BenchMark.Dataset.names.”

```
> DataSetStudy = GSBenchMark.Dataset.names[[9]]
> print(DataSetStudy)

[1] "squamous_GDS2520"

> data(list=DataSetStudy)
```

The data consists of two variables: `exprsdata` and `phenotypes`. `exprsdata` consists of a gene expression matrix where the rows and columns represent genes and the samples respectively. GSReg requires the rownames of gene expression variable represent the gene names, *i.e.* they are represented in the pathway information variable.

The GSReg does not allow any missing data. To comply with the requirements we remove genes with NAs. The user may use any imputation to resolve this issue:

```
> if(sum(apply(is.nan(exprsdata), 1, sum)>0))
  exprsdata = exprsdata[-which(apply(is.nan(exprsdata), 1, sum)>0),];
```

One can extract the gene names by:

```
> genenames = rownames(exprsdata);
> genenames[1:10]

[1] "MAPK3"      "TIE1"      "CYP2C19" "CXCR5"      "CXCR5"      "DUSP1"      "MMP10"      "DDR1"
[9] "EIF2AK2" "HINT1"
```

3 Analysis of the pathways

Here, we demonstrate how to use the GSReg package to compute DIRAC and EVA statistics.

3.1 DIRAC Analysis

First, we load the library:

```
> library(GSReg)
```

The package also implements the alternative EVA statistic in the function `GSReg.GeneSets.DIRAC`. This function receives gene expression as `geneexpres`, the pathway information as `pathways` and phenotypes of samples as a factor with two levels and length equal to column number of `geneexpres`. *DIRAC* uses can use either a permutation test or normal approximation for p-value calculation; so, `GSReg.GeneSets.DIRAC` receives the number of permutations through (`Nperm`) with default value equal to 0 which indicates the normal approximation.

```
> Nperm = 10
> system.time({DIRACperm =GSReg.GeneSets.DIRAC(exprsdata,diracpathways,phenotypes,Nperm=10)})
      user  system elapsed 
2.110    0.321    2.867 
> system.time({DIRACAn =GSReg.GeneSets.DIRAC(exprsdata,diracpathways,phenotypes)})
      user  system elapsed 
0.218    0.074    0.338 
>
```

Here is the histogram of the DIRAC p-values:

```
> hist(DIRACAn$pvalues,xlab="pvalue",main="Hist of pvalues applying DIRAC Analysis.")
```

Hist of pvalues applying DIRAC Analysis.



To check if the approximations are reliable, we plot the z-scores calculated to approximate p-values versus the p-values from the permutation tests.

Figure 2 shows the result of comparing p-value DIRAC computing from 1000 permutation test and approximation using normal approximation (offline generated).

3.2 EVA

The package also implements the alternative EVA statistic in the function `GSReg.GeneSets.EVA`. The function requires the similar inputs as `GSReg.GeneSets.DIRAC` (i.e. `geneexpres`,

```

> plot(x=abs(DIRACAn$zscores),y=DIRACperm$pvalues,xlab="|Z-score|",
      ylab="p-value",col="red1",main="DIRAC p-value comparisons")
> zscorelin <- seq(min(abs(DIRACAn$zscores)),max(abs(DIRACAn$zscores)),by = 0.1)
> pvaltheoretic = (1-pnorm(zscorelin))*2
> lines(x=zscorelin,y=pvaltheoretic,type="l",pch=50,lty=5,col="darkblue")
> legend("topright",legend=c("permutation test","Normal Approx."),
      col=c("red1","blue"),text.col=c("red1","blue"),
      lty=c(NA,1),lwd=c(NA,2.5),pch=c(21,NA))

```

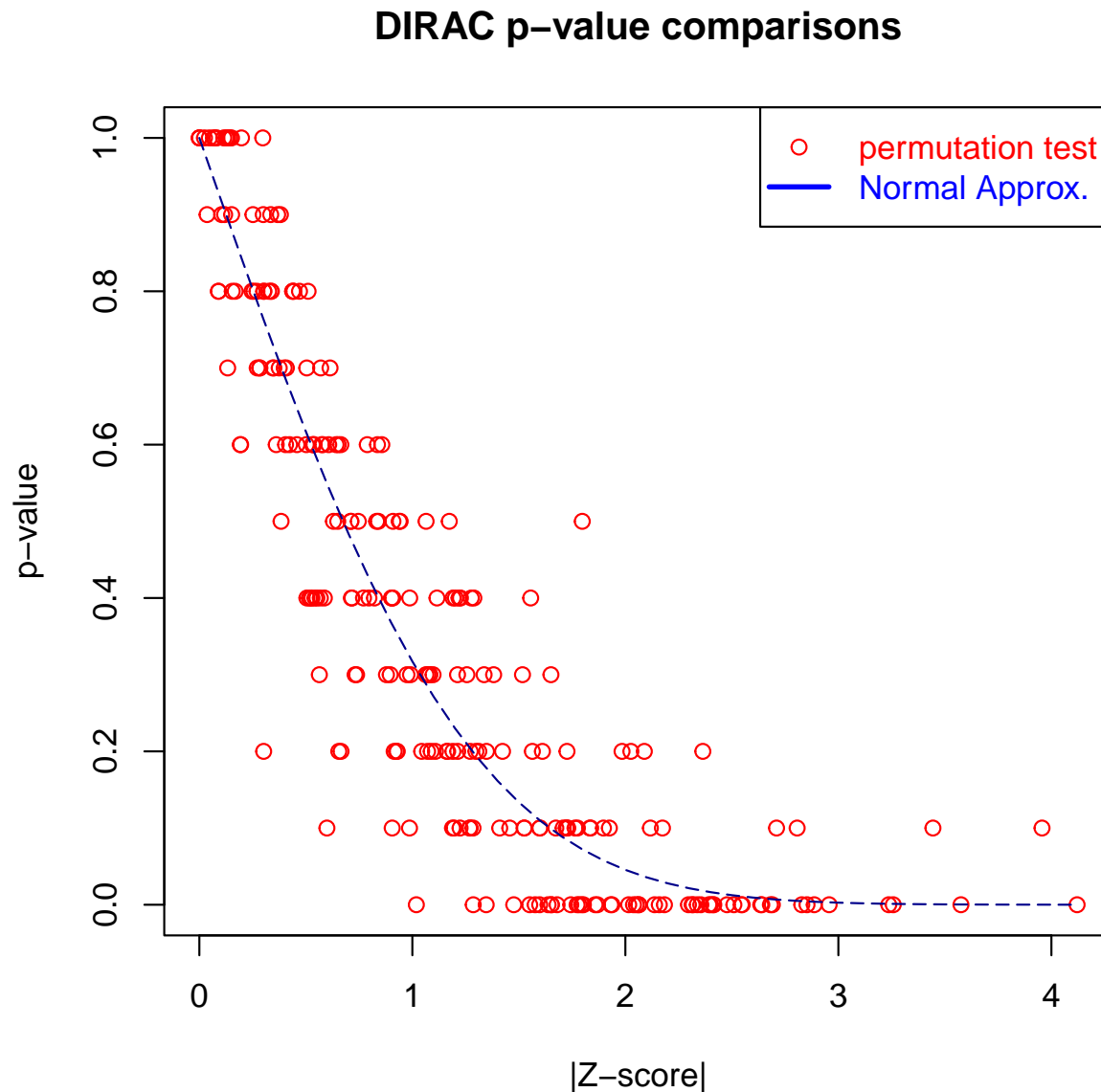


Figure 1: Comparing p-value from permutation test and normal approximation with only 10 permutations.

DIRAC p-value comparisons



Figure 2: Theoretical p-value versus empirical p-value using 1000 permutations.

pathways, phenotypes) except it does not need Nperm since the p-value is not calculated through permutation test but through the mentioned U-statistic theory approach.

```
> #Calculating the variance for the pathways
> #Calculate how much it takes to calculate the statistics and their p-value for all pat
>
> system.time({VarAnKendallV = GSReg.GeneSets.EVA(geneexpres=exprsdata,
  pathways=diracpathways, phenotypes=as.factor(phenotypes)) })
  user  system elapsed
0.353   0.043   0.593

> names(VarAnKendallV)[[1]]

[1] "DEATHPATHWAY"

> VarAnKendallV[[1]]

$E1
[1] 0.09441352

$E2
[1] 0.1310383

$E12
[1] 0.1187962

$zscore
[1] -3.711215

$zscoreD12D1
[1] 3.693266

$zscoreD12D2
[1] -4.005794

$VarEta1
[1] 3.480369e-05

$VarEta2
[1] 6.248694e-05

$sdttotal
[1] 0.009863601

$CovD12D12p
[1] 3.345665e-05

$CovD12D1p2
[1] 0.0006611348

$CovD1D12
```

```

[1] 0.0001258984

$CovD1D12
[1] 0.0001258984

$varTotD12D1
[1] 4.34854e-05

$varTotD12D2
[1] 9.239714e-06

$pvalue
[1] 0.0002062669

$pvalueD12D1
[1] 0.0002213919

$pvalueD12D2
[1] 6.180938e-05

$pvalueTotal
[1] 0.0001854281

$mysdtotal
[1] 0.01159303

```

The output consists of a list. Each element of the list corresponds to a pathway. The element itself is a list. *E1* and *E2* are two fields which contain the measure of variability for phenotype levels (phenotypes) [1] and levels (phenotypes) [2] respectively. Other list elements are *pvalue* and *zscore* which are calculated through the theory of U-statistics and indicate the statistical significance of the difference between *E1* and *E2*.

3.3 Comparison of DIRAC and EVA

We ran the following code to compare statistics from DIRAC and from EVA.

```

> Nperm = 10;
> VarAnPerm = vector(mode="list",length=Nperm)
> for( i in seq_len(Nperm))
{
  VarAnPerm[[i]] = GSReg.GeneSets.EVA(geneexpres=exprsdata, pathways=diracpathways,
                                     phenotypes=sample(phenotypes))
}
> pvaluesperm = vector(mode="numeric",length=length(VarAnPerm[[1]]))
> for( i in seq_along(VarAnPerm[[1]]))
{
  z = sapply(VarAnPerm,function(x) x[[i]]$E1 - x[[i]]$E2)

```

```

    pvaluesperm[i] = mean(abs(VarAnKendallV[[i]]$E1-VarAnKendallV[[i]]$E2)<abs(z))
  }
> zscore = sapply(VarAnKendallV,function(x) x$zscore);
> pvalustat = sapply(VarAnKendallV,function(x) x$pvalue);

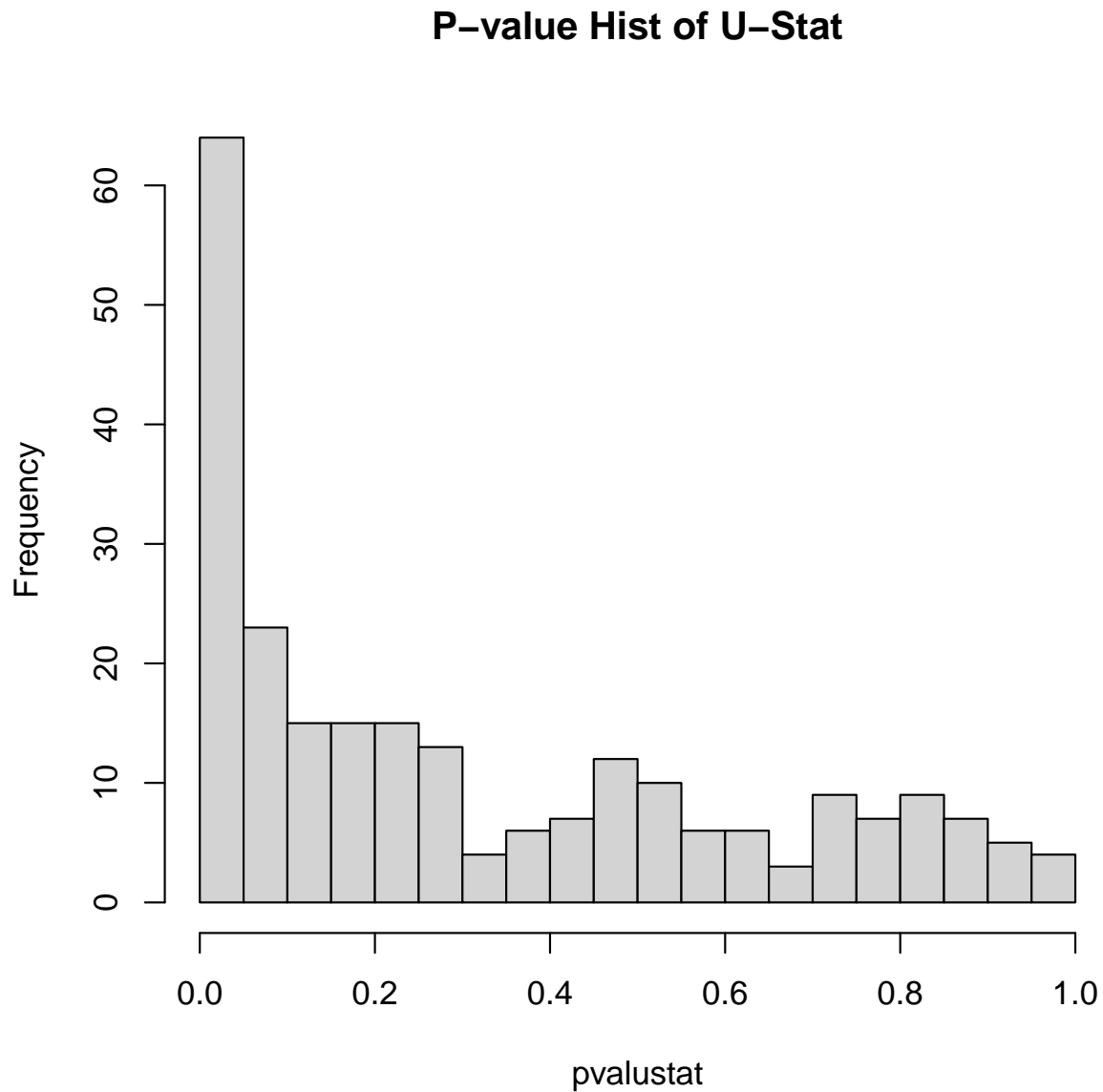
```

The figure represents that the theoretical p-value and p-value calculated from permutation test in EVA are very similar and we can use the theoretical p-value as a surrogate for p-value. Here is the histogram.

```

> hist(x=pvalustat,breaks=20,main="P-value Hist of U-Stat",xlim=c(0,1))

```



```

> plot(x=abs(zscore),y=pvaluesperm,xlab="|Z-score|",
      ylab="p-value",col="red1",main="p-value comparisons")
> zscorelin = seq(0,6,0.1);
> pvaltheoretic = (1-pnorm(zscorelin))*2
> lines(x=zscorelin,y=pvaltheoretic,type="l",pch=50,lty=5,col="darkblue")
> legend("topright",legend=c("permutation test","U-Stat Estimation"),
      col=c("red","blue"),text.col=c("red","blue"),
      lty=c(NA,1),lwd=c(NA,2.5),pch=c(21,NA))

```

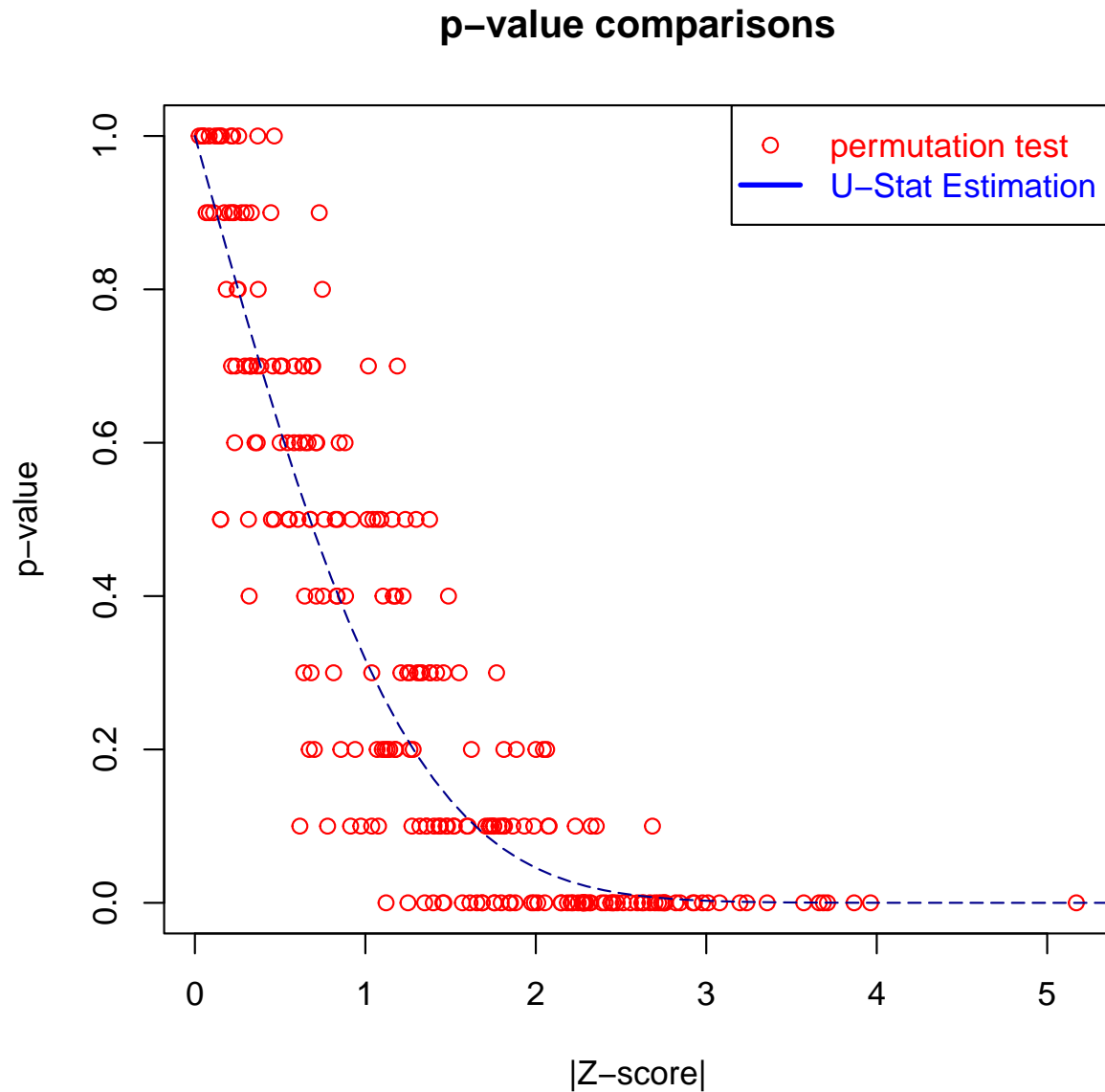


Figure 3: Comparing p-value from permutation test and U-statistic theory with only 10 permutations.

p-value comparisons

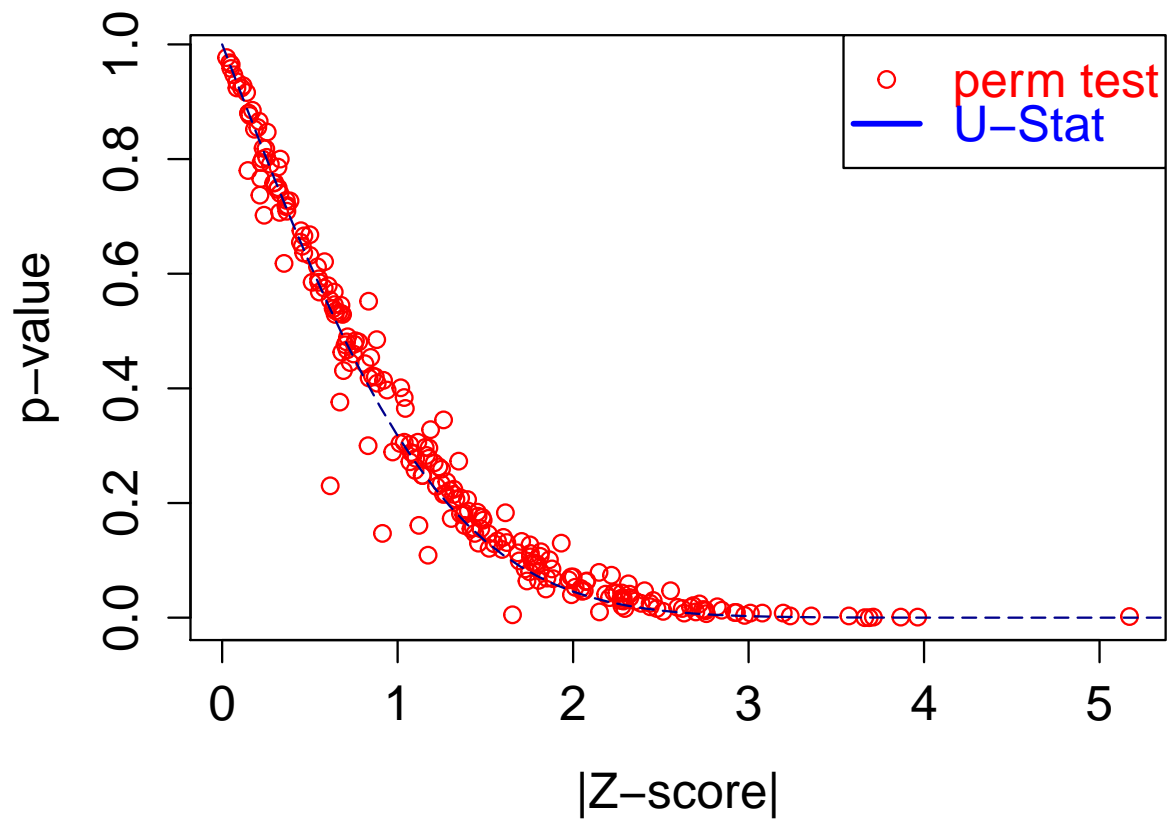


Figure 4: Theoretical p-value versus empirical p-value using 1000 permutations.

Figure 4 shows the result of comparing p-value EVA computing from 1000 permutation test and approximation using U-statistics theory (offline generated).

To compare with the p-value of the DIRAC analysis, we show the p-values of DIRAC versus U-Statistic methodology:

```
> plot(x=DIRACAn$pvalues,y=pvalustat,xlab="DIRAC",
       ylab="EVA",main=sprintf("P-value Comparison corr=%2.2g",cor(x=DIRACAn$pvalues,y=
> lmfit = lm(pvalustat~DIRACAn$pvalues-1)
> abline(lmfit)
> cor.test(x=DIRACAn$pvalues,y=pvalustat)

Pearson's product-moment correlation

data: DIRACAn$pvalues and pvalustat
t = 15.834, df = 238, p-value < 2.2e-16
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.6484375 0.7727928
sample estimates:
      cor
0.7162546
```

P-value Comparison corr=0.72



Also, the correlation of the p-values of DIRAC and U-Statistics is very high:

```
> cor(x=DIRACn$pvalues,y=pvalustat)
[1] 0.7162546
```

If we use 1000 permutations instead of 10 permutations, we can see that the correlation is higher (0.88) as seen in Figure (5). The dysregulated pathways identified by *DIRAC* are the following pathways:

| | | |
|-----------------------------|------------------------|-----------------------|
| [1] "DEATHPATHWAY" | "NEUTROPHILPATHWAY" | "PGC1APATHWAY" |
| [4] "RARRXRPATHWAY" | "SKP2E2FPATHWAY" | "KERATINOCYTEPATHWAY" |
| [7] "CHEMICALPATHWAY" | "TGFBPATHWAY" | "PROTEASOMEPATHWAY" |
| [10] "MAPKPATHWAY" | "PDGFPATHWAY" | "BIOPEPTIDESPATHWAY" |
| [13] "SPPAPATHWAY" | "PYK2PATHWAY" | "MYOSINPATHWAY" |
| [16] "BETAOXIDATIONPATHWAY" | "IL7PATHWAY" | "FMLPPATHWAY" |
| [19] "VITCBPATHWAY" | "CD40PATHWAY" | "CDC25PATHWAY" |
| [22] "MTORPATHWAY" | "RNAPATHWAY" | "FBW7PATHWAY" |
| [25] "LYMPHOCYTEPATHWAY" | "LAIRPATHWAY" | "HIVNEFPATHWAY" |
| [28] "ALKPATHWAY" | "P35ALZHEIMERSPATHWAY" | "MSPPATHWAY" |
| [31] "GSK3PATHWAY" | "RELAPATHWAY" | "METPATHWAY" |
| [34] "TNFR2PATHWAY" | "AT1RPATHWAY" | "FREEPATHWAY" |
| [37] "ARAPPATHWAY" | "MRPPATHWAY" | "P53HYPOXIAPATHWAY" |
| [40] "IL18PATHWAY" | "STRESSPATHWAY" | "MEF2DPATHWAY" |
| [43] "STAT3PATHWAY" | "HSP27PATHWAY" | "EPONFKBPATHWAY" |
| [46] "NKCELLSPATHWAY" | "MONOCYTEPATHWAY" | "CARM_ERPATHWAY" |

DIRAC and EVA have been shown mathematically similar. The main advantages of the EVA is efficiency in calculation as well as easier interpretation. Figure 5 a graphical example of such comparison. One can see that the p-values generated by DIRAC and EVA have high correlation, i.e. 0.88. Note that EVA is much faster than DIRAC. For example, in this case, we ran the computations on a Lenovo Thinkpad with Core(TM) i7-3720QM Intel CPU @2.6 GHz. For a thousand permutation, the DIRAC analysis took 207.47 seconds while the latter only took 0.3 seconds. Note that for multiple hypothesis adjustment, a thousand permutations may not be satisfactory and we require hundreds of thousand or a million permutation which may not be feasible.

Note that it is possible that some of the genes in a pathway are not represented in the expression data or are too short (e.g. less than 5 genes). Both `GSReg.GeneSets.EVA` and `GSReg.GeneSets.DIRAC` may ignore such pathways through parameter `minGeneNum`. Please see the manual for more details. If we the user wants to compare the results of DIRAC and EVA, they can run the following

code for plot DIRAC diagram of significantly perturbed pathways:

```
> DIRACan =GSReg.GeneSets.DIRAC(exprsdata,diracpathways,phenotypes,Nperm=1000)

> significantPathwaysDIRAC = names(DIRACan$mu1)[which(DIRACan$pvalues<0.05)];
> mu1 = DIRACan$mu1[significantPathwaysDIRAC];
> mu2 = DIRACan$mu2[significantPathwaysDIRAC];
> #The dysregulated pathways
> names(mu1)

[1] "DEATHPATHWAY"      "NEUTROPHILPATHWAY"  "PGC1APATHWAY"
[4] "RARRXRPATHWAY"    "SKP2E2FPATHWAY"    "KERATINOCYTEPATHWAY"
[7] "CHEMICALPATHWAY"  "TGFBPATHWAY"       "PROTEASOMEPATHWAY"
[10] "MAPKPATHWAY"      "PDGFPATHWAY"       "BIOPEPTIDESPATHWAY"
[13] "SPPAPATHWAY"      "PYK2PATHWAY"       "MYOSINPATHWAY"
```

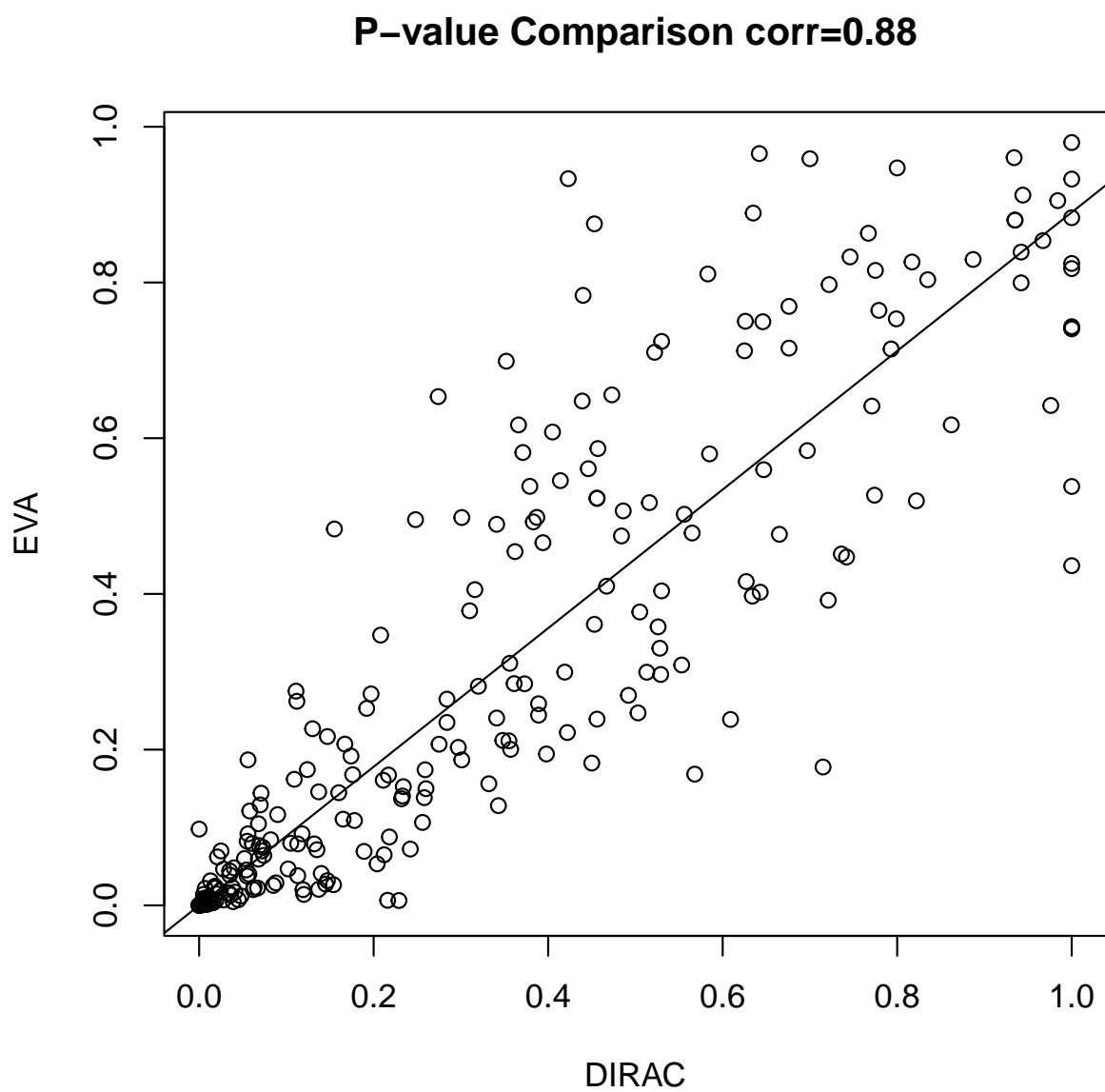



Figure 5: Comparing p-values EVA versus DIRAC. The correlation is 0.88.

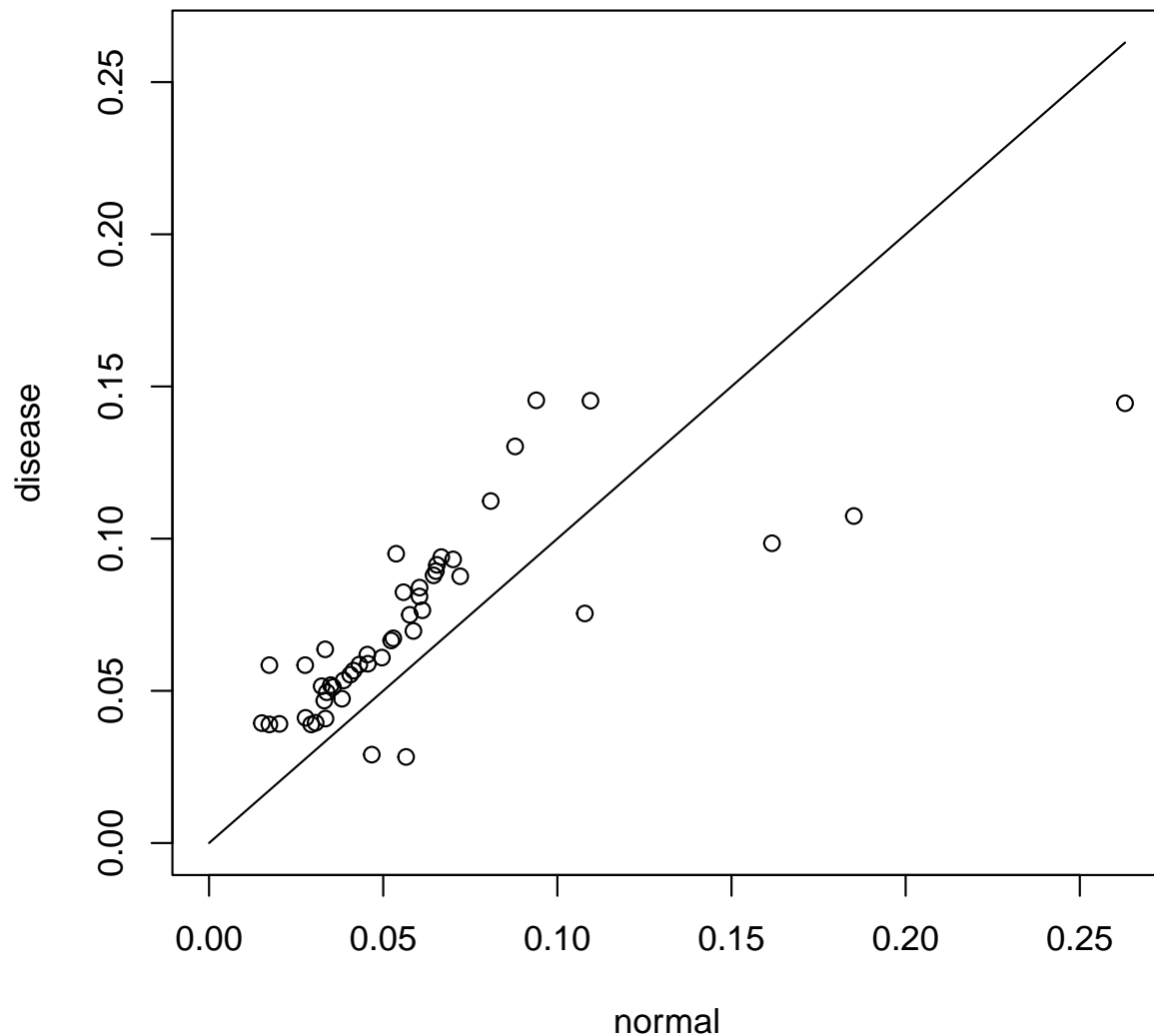
```

[16] "BETAOXIDATIONPATHWAY" "IL7PATHWAY" "FMLPPATHWAY"
[19] "VITCBPATHWAY" "CD40PATHWAY" "CDC25PATHWAY"
[22] "MTORPATHWAY" "RNAPATHWAY" "FBW7PATHWAY"
[25] "LYMPHOCYTEPATHWAY" "LAIRPATHWAY" "HIVNEFPATHWAY"
[28] "ALKPATHWAY" "P35ALZHEIMERSPATHWAY" "MSPPATHWAY"
[31] "GSK3PATHWAY" "RELAPATHWAY" "METPATHWAY"
[34] "TNFR2PATHWAY" "AT1RPATHWAY" "FREEPATHWAY"
[37] "ARAPATHWAY" "MRPPATHWAY" "P53HYPOXIAPATHWAY"
[40] "IL18PATHWAY" "STRESSPATHWAY" "MEF2DPATHWAY"
[43] "STAT3PATHWAY" "HSP27PATHWAY" "EPONFKBPATHWAY"
[46] "NKCELLSPATHWAY" "MONOCYTEPATHWAY" "CARM_ERPATHWAY"

> plot(x=mu1,y=mu2,
      xlim=c(0,max(mu1,mu2)),ylim=c(0,max(mu1,mu2)),xlab="normal",ylab="disease",
      main="(a) DIRAC significantly dysregulated pathways")
> lines(x=c(0,max(mu1,mu2)),y=c(0,max(mu1,mu2)))

```

(a) DIRAC significantly dysregulated pathways



Now, if we do the analysis using EVA, we have:

```
> significantPathwaysGSV = names(which(pvalustat<0.05));

[1] "DEATHPATHWAY"           "TCAPOPTOSISPATHWAY"   "NEUTROPHILPATHWAY"
[4] "PGC1APATHWAY"           "TERCPATHWAY"           "RARRXRPATHWAY"
[7] "SKP2E2FPATHWAY"        "KERATINOCYTEPATHWAY"  "CHEMICALPATHWAY"
[10] "METHIONINEPATHWAY"      "TGFBPATHWAY"          "PS1PATHWAY"
[13] "PROTEASOMEPATHWAY"     "CDK5PATHWAY"          "MAPKPATHWAY"
[16] "NTHIPATHWAY"           "PDGFPATHWAY"          "BIOPEPTIDESPATHWAY"
[19] "SPPAPATHWAY"           "PYK2PATHWAY"          "CDC42RACPATHWAY"
```

```

[22] "MYOSINPATHWAY"      "BETAOXIDATIONPATHWAY" "IL7PATHWAY"
[25] "FMLPPATHWAY"        "FASPATHWAY"          "VITCBPATHWAY"
[28] "CD40PATHWAY"        "IGF1PATHWAY"         "CDC25PATHWAY"
[31] "MTORPATHWAY"        "RNAPATHWAY"          "FBW7PATHWAY"
[34] "LYMPHOCYTEPATHWAY"  "LAIRPATHWAY"         "HIVNEFPATHWAY"
[37] "ALKPATHWAY"         "PEPIPATHWAY"         "MSPPATHWAY"
[40] "EDG1PATHWAY"        "GSK3PATHWAY"         "RELAPATHWAY"
[43] "METPATHWAY"         "TNFR2PATHWAY"        "AT1RPATHWAY"
[46] "ATRBRCAPATHWAY"     "GLYCOLYSISPATHWAY"   "TIDPATHWAY"
[49] "EOPATHWAY"          "WNTPATHWAY"          "ARAPPATHWAY"
[52] "MRPPATHWAY"         "P53HYPOXIAPATHWAY"   "PITX2PATHWAY"
[55] "IL18PATHWAY"        "STRESSPATHWAY"       "MEF2DPATHWAY"
[58] "MITOCHONDRIAPATHWAY" "STAT3PATHWAY"        "EPONFKBPATHWAY"
[61] "NKCELLSPATHWAY"     "MONOCYTEPATHWAY"     "CARM_ERPATHWAY"
[64] "HCMVPATHWAY"

```

```
> eta1 = sapply(VarAnKendallV,function(x) x$E1)[significantPathwaysGSV];
```

| | | | |
|-------------------|---------------------|----------------------|---------------------|
| DEATHPATHWAY | TCAPOPTOSISPATHWAY | NEUTROPHILPATHWAY | PGC1APATHWAY |
| 0.09441352 | 0.08600289 | 0.35559678 | 0.04477053 |
| TERCPATHWAY | RARRXRPATHWAY | SKP2E2FPATHWAY | KERATINOCYTEPATHWAY |
| 0.07316017 | 0.06914038 | 0.03367003 | 0.07404055 |
| CHEMICALPATHWAY | METHIONINEPATHWAY | TGFBPATHWAY | PS1PATHWAY |
| 0.08521303 | 0.09913420 | 0.05028305 | 0.08080808 |
| PROTEASOMEPATHWAY | CDK5PATHWAY | MAPKPATHWAY | NTHIPATHWAY |
| 0.09617180 | 0.07975863 | 0.08504987 | 0.08091115 |
| PDGFPATHWAY | BIOPEPTIDESPATHWAY | SPPAPATHWAY | PYK2PATHWAY |
| 0.08698709 | 0.06767807 | 0.09690598 | 0.04711514 |
| CDC42RACPATHWAY | MYOSINPATHWAY | BETAOXIDATIONPATHWAY | IL7PATHWAY |
| 0.08948195 | 0.09005280 | 0.02683983 | 0.10609668 |
| FMLPPATHWAY | FASPATHWAY | VITCBPATHWAY | CD40PATHWAY |
| 0.05736961 | 0.08676830 | 0.07888408 | 0.05294705 |
| IGF1PATHWAY | CDC25PATHWAY | MTORPATHWAY | RNAPATHWAY |
| 0.09115972 | 0.06265031 | 0.04188827 | 0.03009689 |
| FBW7PATHWAY | LYMPHOCYTEPATHWAY | LAIRPATHWAY | HIVNEFPATHWAY |
| 0.03174603 | 0.22390572 | 0.15222872 | 0.09020600 |
| ALKPATHWAY | PEPIPATHWAY | MSPPATHWAY | EDG1PATHWAY |
| 0.09130361 | 0.05194805 | 0.12150072 | 0.08801738 |
| GSK3PATHWAY | RELAPATHWAY | METPATHWAY | TNFR2PATHWAY |
| 0.11946928 | 0.06302309 | 0.10561315 | 0.05051566 |
| AT1RPATHWAY | ATRBRCAPATHWAY | GLYCOLYSISPATHWAY | TIDPATHWAY |
| 0.05943314 | 0.07166907 | 0.02308802 | 0.07331013 |
| EOPATHWAY | WNTPATHWAY | ARAPPATHWAY | MRPPATHWAY |
| 0.07319696 | 0.10526414 | 0.05988456 | 0.04877345 |
| P53HYPOXIAPATHWAY | PITX2PATHWAY | IL18PATHWAY | STRESSPATHWAY |
| 0.07708666 | 0.09375387 | 0.13015873 | 0.05505364 |
| MEF2DPATHWAY | MITOCHONDRIAPATHWAY | STAT3PATHWAY | EPONFKBPATHWAY |
| 0.04399740 | 0.12572150 | 0.05179344 | 0.07910272 |
| NKCELLSPATHWAY | MONOCYTEPATHWAY | CARM_ERPATHWAY | HCMVPATHWAY |
| 0.07718643 | 0.25171192 | 0.06462137 | 0.07781385 |

```
> eta2 = sapply(VarAnKendallV,function(x) x$E2)[significantPathwaysGSV];
```

| | | | |
|-------------------|---------------------|----------------------|---------------------|
| DEATHPATHWAY | TCAPOPTOSISPATHWAY | NEUTROPHILPATHWAY | PGC1APATHWAY |
| 0.13103827 | 0.04531025 | 0.23546691 | 0.05588351 |
| TERCPATHWAY | RARRXRPATHWAY | SKP2E2FPATHWAY | KERATINOCYTEPATHWAY |
| 0.12770563 | 0.09090909 | 0.05856181 | 0.09013983 |
| CHEMICALPATHWAY | METHIONINEPATHWAY | TGFBPATHWAY | PS1PATHWAY |
| 0.11832612 | 0.15454545 | 0.07165057 | 0.12332852 |
| PROTEASOMEPATHWAY | CDK5PATHWAY | MAPKPATHWAY | NTHIPATHWAY |
| 0.13083213 | 0.10251869 | 0.10114801 | 0.09532055 |
| PDGFPATHWAY | BIOPEPTIDESPATHWAY | SPPAPATHWAY | PYK2PATHWAY |
| 0.11066711 | 0.08559859 | 0.12604711 | 0.06023958 |
| CDC42RACPATHWAY | MYOSINPATHWAY | BETAOXIDATIONPATHWAY | IL7PATHWAY |
| 0.11283954 | 0.11997526 | 0.06147186 | 0.13455988 |
| FMLPPATHWAY | FASPATHWAY | VITCBPATHWAY | CD40PATHWAY |
| 0.06840858 | 0.10725265 | 0.04252044 | 0.08041958 |
| IGF1PATHWAY | CDC25PATHWAY | MTORPATHWAY | RNAPATHWAY |
| 0.12087036 | 0.04413179 | 0.05994640 | 0.08719852 |
| FBW7PATHWAY | LYMPHOCYTEPATHWAY | LAIRPATHWAY | HIVNEFPATHWAY |
| 0.06307978 | 0.16065416 | 0.11574140 | 0.11884884 |
| ALKPATHWAY | PEPIPATHWAY | MSPPATHWAY | EDG1PATHWAY |
| 0.11181840 | 0.13593074 | 0.17344877 | 0.11010728 |
| GSK3PATHWAY | RELAPATHWAY | METPATHWAY | TNFR2PATHWAY |
| 0.16320909 | 0.08203463 | 0.12858234 | 0.07308378 |
| AT1RPATHWAY | ATRBRCAPATHWAY | GLYCOLYSISPATHWAY | TIDPATHWAY |
| 0.08115533 | 0.08771185 | 0.05112348 | 0.09458733 |
| EPOPATHWAY | WNTPATHWAY | ARAPPATHWAY | MRPPATHWAY |
| 0.09569080 | 0.12762130 | 0.07615440 | 0.08571429 |
| P53HYPOXIAPATHWAY | PITX2PATHWAY | IL18PATHWAY | STRESSPATHWAY |
| 0.09759247 | 0.11618223 | 0.18989899 | 0.07523998 |
| MEF2DPATHWAY | MITOCHONDRIAPATHWAY | STAT3PATHWAY | EPONFKBPATHWAY |
| 0.05508870 | 0.16778499 | 0.09647495 | 0.13372688 |
| NKCELLSPATHWAY | MONOCYTEPATHWAY | CARM_ERPATHWAY | HCMVPATHWAY |
| 0.09574739 | 0.17662338 | 0.08397641 | 0.08899711 |

```
> #The dysregulated pathways
> names(etal)
```

| | | |
|--------------------------|------------------------|----------------------|
| [1] "DEATHPATHWAY" | "TCAPOPTOSISPATHWAY" | "NEUTROPHILPATHWAY" |
| [4] "PGC1APATHWAY" | "TERCPATHWAY" | "RARRXRPATHWAY" |
| [7] "SKP2E2FPATHWAY" | "KERATINOCYTEPATHWAY" | "CHEMICALPATHWAY" |
| [10] "METHIONINEPATHWAY" | "TGFBPATHWAY" | "PS1PATHWAY" |
| [13] "PROTEASOMEPATHWAY" | "CDK5PATHWAY" | "MAPKPATHWAY" |
| [16] "NTHIPATHWAY" | "PDGFPATHWAY" | "BIOPEPTIDESPATHWAY" |
| [19] "SPPAPATHWAY" | "PYK2PATHWAY" | "CDC42RACPATHWAY" |
| [22] "MYOSINPATHWAY" | "BETAOXIDATIONPATHWAY" | "IL7PATHWAY" |
| [25] "FMLPPATHWAY" | "FASPATHWAY" | "VITCBPATHWAY" |
| [28] "CD40PATHWAY" | "IGF1PATHWAY" | "CDC25PATHWAY" |
| [31] "MTORPATHWAY" | "RNAPATHWAY" | "FBW7PATHWAY" |
| [34] "LYMPHOCYTEPATHWAY" | "LAIRPATHWAY" | "HIVNEFPATHWAY" |
| [37] "ALKPATHWAY" | "PEPIPATHWAY" | "MSPPATHWAY" |
| [40] "EDG1PATHWAY" | "GSK3PATHWAY" | "RELAPATHWAY" |
| [43] "METPATHWAY" | "TNFR2PATHWAY" | "AT1RPATHWAY" |
| [46] "ATRBRCAPATHWAY" | "GLYCOLYSISPATHWAY" | "TIDPATHWAY" |

```

[49] "EPOPATHWAY"          "WNTPATHWAY"          "ARAPPATHWAY"
[52] "MRPPATHWAY"          "P53HYPOXIAPATHWAY"  "PITX2PATHWAY"
[55] "IL18PATHWAY"         "STRESSPATHWAY"      "MEF2DPATHWAY"
[58] "MITOCHONDRIAPATHWAY" "STAT3PATHWAY"        "EPONFKBPATHWAY"
[61] "NKCELLSPATHWAY"      "MONOCYTEPATHWAY"     "CARM_ERPATHWAY"
[64] "HCMVPATHWAY"

> plot(x=eta1,y=eta2,xlim=c(0,max(eta1,eta2)),ylim=c(0,max(eta1,eta2)),xlab="normal",ylab="normal",
      main="(b) EVA: Dysregulated pathways")

NULL

> lines(x=c(0,max(eta1,eta2)),y=c(0,max(eta1,eta2)))

NULL

```

(b) EVA: Dysregulated pathways



Although there is discrepancy in identified dysregulated pathways ($p\text{-value} < 0.05$), the general trend found in [1] holds still true. The trend is that usually the dysregulated pathways have higher variability measure in more dangerous phenotypes. The figures reveal that both DIRAC and EVA have this property. DIRAC found 48 dysregulated pathways and EVA discovered 64 pathways, 45 pathways showed up in both analysis, and 67 pathways were discovered totally.

```
> print(significantPathwaysGSV)
[1] "DEATHPATHWAY"          "TCAPOPTOSISPATHWAY"   "NEUTROPHILPATHWAY"
```

| | | | |
|------|-----------------------|------------------------|----------------------|
| [4] | "PGC1APATHWAY" | "TERCPATHWAY" | "RARRXRPATHWAY" |
| [7] | "SKP2E2FPATHWAY" | "KERATINOCYTEPATHWAY" | "CHEMICALPATHWAY" |
| [10] | "METHIONINEPATHWAY" | "TGFBPATHWAY" | "PS1PATHWAY" |
| [13] | "PROTEASOMEPATHWAY" | "CDK5PATHWAY" | "MAPKPATHWAY" |
| [16] | "NTHIPATHWAY" | "PDGFPATHWAY" | "BIOPEPTIDESPATHWAY" |
| [19] | "SPPAPATHWAY" | "PYK2PATHWAY" | "CDC42RACPATHWAY" |
| [22] | "MYOSINPATHWAY" | "BETAOXIDATIONPATHWAY" | "IL7PATHWAY" |
| [25] | "FMLPPATHWAY" | "FASPATHWAY" | "VITCBPATHWAY" |
| [28] | "CD40PATHWAY" | "IGF1PATHWAY" | "CDC25PATHWAY" |
| [31] | "MTORPATHWAY" | "RNAPATHWAY" | "FBW7PATHWAY" |
| [34] | "LYMPHOCYTEPATHWAY" | "LAIRPATHWAY" | "HIVNEFPATHWAY" |
| [37] | "ALKPATHWAY" | "PEPIPATHWAY" | "MSPPATHWAY" |
| [40] | "EDG1PATHWAY" | "GSK3PATHWAY" | "RELAPATHWAY" |
| [43] | "METPATHWAY" | "TNFR2PATHWAY" | "AT1RPATHWAY" |
| [46] | "ATRBRCPATHWAY" | "GLYCOLYSISPATHWAY" | "TIDPATHWAY" |
| [49] | "EOPATHWAY" | "WNTPATHWAY" | "ARAPPATHWAY" |
| [52] | "MRPPATHWAY" | "P53HYPOXIAPATHWAY" | "PITX2PATHWAY" |
| [55] | "IL18PATHWAY" | "STRESSPATHWAY" | "MEF2DPATHWAY" |
| [58] | "MITOCHONDRIAPATHWAY" | "STAT3PATHWAY" | "EPONFKBPATHWAY" |
| [61] | "NKCELLSPATHWAY" | "MONOCYTEPATHWAY" | "CARM_ERPATHWAY" |
| [64] | "HCMVPATHWAY" | | |
| [1] | "DEATHPATHWAY" | "TCAPOPTOSISPATHWAY" | "NEUTROPHILPATHWAY" |
| [4] | "PGC1APATHWAY" | "TERCPATHWAY" | "RARRXRPATHWAY" |
| [7] | "SKP2E2FPATHWAY" | "KERATINOCYTEPATHWAY" | "CHEMICALPATHWAY" |
| [10] | "METHIONINEPATHWAY" | "TGFBPATHWAY" | "PS1PATHWAY" |
| [13] | "PROTEASOMEPATHWAY" | "CDK5PATHWAY" | "MAPKPATHWAY" |
| [16] | "NTHIPATHWAY" | "PDGFPATHWAY" | "BIOPEPTIDESPATHWAY" |
| [19] | "SPPAPATHWAY" | "PYK2PATHWAY" | "CDC42RACPATHWAY" |
| [22] | "MYOSINPATHWAY" | "BETAOXIDATIONPATHWAY" | "IL7PATHWAY" |
| [25] | "FMLPPATHWAY" | "FASPATHWAY" | "VITCBPATHWAY" |
| [28] | "CD40PATHWAY" | "IGF1PATHWAY" | "CDC25PATHWAY" |
| [31] | "MTORPATHWAY" | "RNAPATHWAY" | "FBW7PATHWAY" |
| [34] | "LYMPHOCYTEPATHWAY" | "LAIRPATHWAY" | "HIVNEFPATHWAY" |
| [37] | "ALKPATHWAY" | "PEPIPATHWAY" | "MSPPATHWAY" |
| [40] | "EDG1PATHWAY" | "GSK3PATHWAY" | "RELAPATHWAY" |
| [43] | "METPATHWAY" | "TNFR2PATHWAY" | "AT1RPATHWAY" |
| [46] | "ATRBRCPATHWAY" | "GLYCOLYSISPATHWAY" | "TIDPATHWAY" |
| [49] | "EOPATHWAY" | "WNTPATHWAY" | "ARAPPATHWAY" |
| [52] | "MRPPATHWAY" | "P53HYPOXIAPATHWAY" | "PITX2PATHWAY" |
| [55] | "IL18PATHWAY" | "STRESSPATHWAY" | "MEF2DPATHWAY" |
| [58] | "MITOCHONDRIAPATHWAY" | "STAT3PATHWAY" | "EPONFKBPATHWAY" |
| [61] | "NKCELLSPATHWAY" | "MONOCYTEPATHWAY" | "CARM_ERPATHWAY" |
| [64] | "HCMVPATHWAY" | | |

> print(significantPathwaysDIRAC)

| | | | |
|------|------------------------|---------------------|-----------------------|
| [1] | "DEATHPATHWAY" | "NEUTROPHILPATHWAY" | "PGC1APATHWAY" |
| [4] | "RARRXRPATHWAY" | "SKP2E2FPATHWAY" | "KERATINOCYTEPATHWAY" |
| [7] | "CHEMICALPATHWAY" | "TGFBPATHWAY" | "PROTEASOMEPATHWAY" |
| [10] | "MAPKPATHWAY" | "PDGFPATHWAY" | "BIOPEPTIDESPATHWAY" |
| [13] | "SPPAPATHWAY" | "PYK2PATHWAY" | "MYOSINPATHWAY" |
| [16] | "BETAOXIDATIONPATHWAY" | "IL7PATHWAY" | "FMLPPATHWAY" |

| | | |
|-----------------------------|------------------------|-----------------------|
| [19] "VITCBPATHWAY" | "CD40PATHWAY" | "CDC25PATHWAY" |
| [22] "MTORPATHWAY" | "RNAPATHWAY" | "FBW7PATHWAY" |
| [25] "LYMPHOCYTEPATHWAY" | "LAIRPATHWAY" | "HIVNEFPATHWAY" |
| [28] "ALKPATHWAY" | "P35ALZHEIMERSPATHWAY" | "MSPPATHWAY" |
| [31] "GSK3PATHWAY" | "RELAPATHWAY" | "METPATHWAY" |
| [34] "TNFR2PATHWAY" | "AT1RPATHWAY" | "FREEPATHWAY" |
| [37] "ARAPPATHWAY" | "MRPPATHWAY" | "P53HYPOXIAPATHWAY" |
| [40] "IL18PATHWAY" | "STRESSPATHWAY" | "MEF2DPATHWAY" |
| [43] "STAT3PATHWAY" | "HSP27PATHWAY" | "EPONFKBPATHWAY" |
| [46] "NKCELLSPATHWAY" | "MONOCYTEPATHWAY" | "CARM_ERPATHWAY" |
| [1] "DEATHPATHWAY" | "NEUTROPHILPATHWAY" | "PGC1APATHWAY" |
| [4] "RARRXRPATHWAY" | "SKP2E2FPATHWAY" | "KERATINOCYTEPATHWAY" |
| [7] "CHEMICALPATHWAY" | "TGFBPATHWAY" | "PROTEASOMEPATHWAY" |
| [10] "MAPKPATHWAY" | "PDGFPATHWAY" | "BIOPEPTIDESPATHWAY" |
| [13] "SPPAPATHWAY" | "PYK2PATHWAY" | "MYOSINPATHWAY" |
| [16] "BETAOXIDATIONPATHWAY" | "IL7PATHWAY" | "FMLPPATHWAY" |
| [19] "VITCBPATHWAY" | "CD40PATHWAY" | "CDC25PATHWAY" |
| [22] "MTORPATHWAY" | "RNAPATHWAY" | "FBW7PATHWAY" |
| [25] "LYMPHOCYTEPATHWAY" | "LAIRPATHWAY" | "HIVNEFPATHWAY" |
| [28] "ALKPATHWAY" | "P35ALZHEIMERSPATHWAY" | "MSPPATHWAY" |
| [31] "GSK3PATHWAY" | "RELAPATHWAY" | "METPATHWAY" |
| [34] "TNFR2PATHWAY" | "AT1RPATHWAY" | "FREEPATHWAY" |
| [37] "ARAPPATHWAY" | "MRPPATHWAY" | "P53HYPOXIAPATHWAY" |
| [40] "IL18PATHWAY" | "STRESSPATHWAY" | "MEF2DPATHWAY" |
| [43] "STAT3PATHWAY" | "HSP27PATHWAY" | "EPONFKBPATHWAY" |
| [46] "NKCELLSPATHWAY" | "MONOCYTEPATHWAY" | "CARM_ERPATHWAY" |

3.4 Splice-EVA Analysis

SEVA needs junction overlap matrices. This can be done by function `GSReg.overlapJunction`. Here is a piece of code which shows how to use this function.

```
> require('Homo.sapiens')
[1] TRUE

> require('org.Hs.eg.db')
[1] TRUE

> require('GenomicRanges')
[1] TRUE

> data(juncExprsSimulated)
[1] "juncExprsSimulated"

> overlapMat <- GSReg.overlapJunction(juncExprs = junc.RPM.Simulated,
                                     geneexpr = geneExprsGSReg)
```

\$Rest

\$Rest\$CMPK1

| | | |
|------------------------|------------------------|------------------------|
| | chr1:47799788-47834141 | chr1:47834287-47838627 |
| chr1:47799788-47834141 | 1 | 0 |
| chr1:47834287-47838627 | 0 | 1 |
| chr1:47838779-47840581 | 0 | 0 |
| chr1:47838779-47840869 | 0 | 0 |
| chr1:47840657-47840869 | 0 | 0 |
| chr1:47840965-47842376 | 0 | 0 |
| | chr1:47838779-47840581 | chr1:47838779-47840869 |
| chr1:47799788-47834141 | 0 | 0 |
| chr1:47834287-47838627 | 0 | 0 |
| chr1:47838779-47840581 | 1 | 1 |
| chr1:47838779-47840869 | 1 | 1 |
| chr1:47840657-47840869 | 0 | 1 |
| chr1:47840965-47842376 | 0 | 0 |
| | chr1:47840657-47840869 | chr1:47840965-47842376 |
| chr1:47799788-47834141 | 0 | 0 |
| chr1:47834287-47838627 | 0 | 0 |
| chr1:47838779-47840581 | 0 | 0 |
| chr1:47838779-47840869 | 1 | 0 |
| chr1:47840657-47840869 | 1 | 0 |
| chr1:47840965-47842376 | 0 | 1 |

\$Rest\$CSF1

| | | |
|--------------------------|--------------------------|--------------------------|
| | chr1:110453684-110456881 | chr1:110457003-110458256 |
| chr1:110453684-110456881 | 1 | 0 |
| chr1:110457003-110458256 | 0 | 1 |
| chr1:110458318-110459915 | 0 | 0 |
| chr1:110460085-110464469 | 0 | 0 |
| chr1:110464616-110465788 | 0 | 0 |
| chr1:110464616-110466682 | 0 | 0 |
| chr1:110466812-110467398 | 0 | 0 |
| chr1:110467450-110467769 | 0 | 0 |
| chr1:110467824-110468685 | 0 | 0 |
| chr1:110467824-110471474 | 0 | 0 |
| | chr1:110458318-110459915 | chr1:110460085-110464469 |
| chr1:110453684-110456881 | 0 | 0 |
| chr1:110457003-110458256 | 0 | 0 |
| chr1:110458318-110459915 | 1 | 0 |
| chr1:110460085-110464469 | 0 | 1 |
| chr1:110464616-110465788 | 0 | 0 |
| chr1:110464616-110466682 | 0 | 0 |
| chr1:110466812-110467398 | 0 | 0 |
| chr1:110467450-110467769 | 0 | 0 |
| chr1:110467824-110468685 | 0 | 0 |
| chr1:110467824-110471474 | 0 | 0 |
| | chr1:110464616-110465788 | chr1:110464616-110466682 |
| chr1:110453684-110456881 | 0 | 0 |
| chr1:110457003-110458256 | 0 | 0 |
| chr1:110458318-110459915 | 0 | 0 |

| | | |
|--------------------------|---|---|
| chr1:110460085-110464469 | 0 | 0 |
| chr1:110464616-110465788 | 1 | 1 |
| chr1:110464616-110466682 | 1 | 1 |
| chr1:110466812-110467398 | 0 | 0 |
| chr1:110467450-110467769 | 0 | 0 |
| chr1:110467824-110468685 | 0 | 0 |
| chr1:110467824-110471474 | 0 | 0 |
| chr1:110453684-110456881 | 0 | 0 |
| chr1:110457003-110458256 | 0 | 0 |
| chr1:110458318-110459915 | 0 | 0 |
| chr1:110460085-110464469 | 0 | 0 |
| chr1:110464616-110465788 | 0 | 0 |
| chr1:110464616-110466682 | 0 | 0 |
| chr1:110466812-110467398 | 1 | 0 |
| chr1:110467450-110467769 | 0 | 1 |
| chr1:110467824-110468685 | 0 | 0 |
| chr1:110467824-110471474 | 0 | 0 |
| chr1:110453684-110456881 | 0 | 0 |
| chr1:110457003-110458256 | 0 | 0 |
| chr1:110458318-110459915 | 0 | 0 |
| chr1:110460085-110464469 | 0 | 0 |
| chr1:110464616-110465788 | 0 | 0 |
| chr1:110464616-110466682 | 0 | 0 |
| chr1:110466812-110467398 | 0 | 0 |
| chr1:110467450-110467769 | 0 | 0 |
| chr1:110467824-110468685 | 1 | 1 |
| chr1:110467824-110471474 | 1 | 1 |
| \$Rest\$FAM72B | | |
| chr1:120839865-120841975 | 1 | 1 |
| chr1:120839985-120841975 | 1 | 1 |
| chr1:120842052-120845995 | 0 | 0 |
| chr1:120846119-120854492 | 0 | 0 |
| chr1:120839865-120841975 | 0 | 0 |
| chr1:120839985-120841975 | 0 | 0 |
| chr1:120842052-120845995 | 1 | 0 |
| chr1:120846119-120854492 | 0 | 1 |
| \$Rest\$KCNAB2 | | |
| chr1:6046387-6052304 | 1 | |
| \$Rest\$KLHL12 | | |
| chr1:202861787-202862367 | 1 | 1 |
| chr1:202861787-202863312 | 1 | 1 |
| chr1:202862553-202863312 | 0 | 1 |

| | | |
|--------------------------|--------------------------|---|
| chr1:202863410-202863719 | 0 | 0 |
| chr1:202863877-202864650 | 0 | 0 |
| chr1:202863877-202878138 | 0 | 0 |
| chr1:202864845-202865982 | 0 | 0 |
| chr1:202866088-202878138 | 0 | 0 |
| chr1:202878252-202880182 | 0 | 0 |
| chr1:202880331-202887299 | 0 | 0 |
| chr1:202887516-202888883 | 0 | 0 |
| chr1:202889036-202894096 | 0 | 0 |
| chr1:202894335-202896217 | 0 | 0 |
| chr1:202862553-202863312 | chr1:202863410-202863719 | |
| chr1:202861787-202862367 | 0 | 0 |
| chr1:202861787-202863312 | 1 | 0 |
| chr1:202862553-202863312 | 1 | 0 |
| chr1:202863410-202863719 | 0 | 1 |
| chr1:202863877-202864650 | 0 | 0 |
| chr1:202863877-202878138 | 0 | 0 |
| chr1:202864845-202865982 | 0 | 0 |
| chr1:202866088-202878138 | 0 | 0 |
| chr1:202878252-202880182 | 0 | 0 |
| chr1:202880331-202887299 | 0 | 0 |
| chr1:202887516-202888883 | 0 | 0 |
| chr1:202889036-202894096 | 0 | 0 |
| chr1:202894335-202896217 | 0 | 0 |
| chr1:202863877-202864650 | chr1:202863877-202878138 | |
| chr1:202861787-202862367 | 0 | 0 |
| chr1:202861787-202863312 | 0 | 0 |
| chr1:202862553-202863312 | 0 | 0 |
| chr1:202863410-202863719 | 0 | 0 |
| chr1:202863877-202864650 | 1 | 1 |
| chr1:202863877-202878138 | 1 | 1 |
| chr1:202864845-202865982 | 0 | 1 |
| chr1:202866088-202878138 | 0 | 1 |
| chr1:202878252-202880182 | 0 | 0 |
| chr1:202880331-202887299 | 0 | 0 |
| chr1:202887516-202888883 | 0 | 0 |
| chr1:202889036-202894096 | 0 | 0 |
| chr1:202894335-202896217 | 0 | 0 |
| chr1:202864845-202865982 | chr1:202866088-202878138 | |
| chr1:202861787-202862367 | 0 | 0 |
| chr1:202861787-202863312 | 0 | 0 |
| chr1:202862553-202863312 | 0 | 0 |
| chr1:202863410-202863719 | 0 | 0 |
| chr1:202863877-202864650 | 0 | 0 |
| chr1:202863877-202878138 | 1 | 1 |
| chr1:202864845-202865982 | 1 | 0 |
| chr1:202866088-202878138 | 0 | 1 |
| chr1:202878252-202880182 | 0 | 0 |
| chr1:202880331-202887299 | 0 | 0 |
| chr1:202887516-202888883 | 0 | 0 |
| chr1:202889036-202894096 | 0 | 0 |

| | | |
|--------------------------|--------------------------|---|
| chr1:202894335-202896217 | 0 | 0 |
| | chr1:202878252-202880182 | chr1:202880331-202887299 |
| chr1:202861787-202862367 | 0 | 0 |
| chr1:202861787-202863312 | 0 | 0 |
| chr1:202862553-202863312 | 0 | 0 |
| chr1:202863410-202863719 | 0 | 0 |
| chr1:202863877-202864650 | 0 | 0 |
| chr1:202863877-202878138 | 0 | 0 |
| chr1:202864845-202865982 | 0 | 0 |
| chr1:202866088-202878138 | 0 | 0 |
| chr1:202878252-202880182 | 1 | 0 |
| chr1:202880331-202887299 | 0 | 1 |
| chr1:202887516-202888883 | 0 | 0 |
| chr1:202889036-202894096 | 0 | 0 |
| chr1:202894335-202896217 | 0 | 0 |
| | chr1:202887516-202888883 | chr1:202889036-202894096 |
| chr1:202861787-202862367 | 0 | 0 |
| chr1:202861787-202863312 | 0 | 0 |
| chr1:202862553-202863312 | 0 | 0 |
| chr1:202863410-202863719 | 0 | 0 |
| chr1:202863877-202864650 | 0 | 0 |
| chr1:202863877-202878138 | 0 | 0 |
| chr1:202864845-202865982 | 0 | 0 |
| chr1:202866088-202878138 | 0 | 0 |
| chr1:202878252-202880182 | 0 | 0 |
| chr1:202880331-202887299 | 0 | 0 |
| chr1:202887516-202888883 | 1 | 0 |
| chr1:202889036-202894096 | 0 | 1 |
| chr1:202894335-202896217 | 0 | 0 |
| | chr1:202894335-202896217 | |
| chr1:202861787-202862367 | 0 | |
| chr1:202861787-202863312 | 0 | |
| chr1:202862553-202863312 | 0 | |
| chr1:202863410-202863719 | 0 | |
| chr1:202863877-202864650 | 0 | |
| chr1:202863877-202878138 | 0 | |
| chr1:202864845-202865982 | 0 | |
| chr1:202866088-202878138 | 0 | |
| chr1:202878252-202880182 | 0 | |
| chr1:202880331-202887299 | 0 | |
| chr1:202887516-202888883 | 0 | |
| chr1:202889036-202894096 | 0 | |
| chr1:202894335-202896217 | 1 | |
| \$Rest\$KLHL21 | | |
| | chr1:6653718-6655545 | chr1:6655617-6659107 chr1:6659512-6659810 |
| chr1:6653718-6655545 | 1 | 0 0 |
| chr1:6655617-6659107 | 0 | 1 0 |
| chr1:6659512-6659810 | 0 | 0 1 |
| chr1:6659512-6661857 | 0 | 0 1 |
| | chr1:6659512-6661857 | |

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| chr1:6653718-6655545 | 0 | |
| chr1:6655617-6659107 | 0 | |
| chr1:6659512-6659810 | 1 | |
| chr1:6659512-6661857 | 1 | |
| \$Rest\$LOC105371470 | | |
| | chr1:160709146-160717984 | chr1:160709146-160719611 |
| chr1:160709146-160717984 | 1 | 1 |
| chr1:160709146-160719611 | 1 | 1 |
| chr1:160718304-160719611 | 0 | 1 |
| chr1:160719883-160720094 | 0 | 0 |
| chr1:160719922-160720094 | 0 | 0 |
| chr1:160720213-160721135 | 0 | 0 |
| chr1:160720213-160721976 | 0 | 0 |
| chr1:160721238-160721976 | 0 | 0 |
| chr1:160722038-160722896 | 0 | 0 |
| | chr1:160718304-160719611 | chr1:160719883-160720094 |
| chr1:160709146-160717984 | 0 | 0 |
| chr1:160709146-160719611 | 1 | 0 |
| chr1:160718304-160719611 | 1 | 0 |
| chr1:160719883-160720094 | 0 | 1 |
| chr1:160719922-160720094 | 0 | 1 |
| chr1:160720213-160721135 | 0 | 0 |
| chr1:160720213-160721976 | 0 | 0 |
| chr1:160721238-160721976 | 0 | 0 |
| chr1:160722038-160722896 | 0 | 0 |
| | chr1:160719922-160720094 | chr1:160720213-160721135 |
| chr1:160709146-160717984 | 0 | 0 |
| chr1:160709146-160719611 | 0 | 0 |
| chr1:160718304-160719611 | 0 | 0 |
| chr1:160719883-160720094 | 1 | 0 |
| chr1:160719922-160720094 | 1 | 0 |
| chr1:160720213-160721135 | 0 | 1 |
| chr1:160720213-160721976 | 0 | 1 |
| chr1:160721238-160721976 | 0 | 0 |
| chr1:160722038-160722896 | 0 | 0 |
| | chr1:160720213-160721976 | chr1:160721238-160721976 |
| chr1:160709146-160717984 | 0 | 0 |
| chr1:160709146-160719611 | 0 | 0 |
| chr1:160718304-160719611 | 0 | 0 |
| chr1:160719883-160720094 | 0 | 0 |
| chr1:160719922-160720094 | 0 | 0 |
| chr1:160720213-160721135 | 1 | 0 |
| chr1:160720213-160721976 | 1 | 1 |
| chr1:160721238-160721976 | 1 | 1 |
| chr1:160722038-160722896 | 0 | 0 |
| | chr1:160722038-160722896 | |
| chr1:160709146-160717984 | 0 | |
| chr1:160709146-160719611 | 0 | |
| chr1:160718304-160719611 | 0 | |
| chr1:160719883-160720094 | 0 | |

| | | |
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| chr1:160719922-160720094 | 0 | |
| chr1:160720213-160721135 | 0 | |
| chr1:160720213-160721976 | 0 | |
| chr1:160721238-160721976 | 0 | |
| chr1:160722038-160722896 | 1 | |
| \$Rest\$MIR4632 | | |
| | chr1:12251142-12251831 | |
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| \$Rest\$MYSM1 | | |
| | chr1:59125827-59126842 | chr1:59126899-59127078 |
| chr1:59125827-59126842 | 1 | 0 |
| chr1:59126899-59127078 | 0 | 1 |
| chr1:59127183-59131171 | 0 | 0 |
| chr1:59131303-59132710 | 0 | 0 |
| chr1:59132898-59133519 | 0 | 0 |
| chr1:59133593-59134102 | 0 | 0 |
| chr1:59133593-59134304 | 0 | 0 |
| chr1:59134238-59134656 | 0 | 0 |
| chr1:59134354-59134656 | 0 | 0 |
| chr1:59134710-59137542 | 0 | 0 |
| chr1:59137630-59139245 | 0 | 0 |
| chr1:59139322-59141149 | 0 | 0 |
| chr1:59141252-59142598 | 0 | 0 |
| chr1:59142728-59147457 | 0 | 0 |
| chr1:59148217-59150825 | 0 | 0 |
| chr1:59150923-59154710 | 0 | 0 |
| chr1:59154788-59155898 | 0 | 0 |
| chr1:59155921-59156012 | 0 | 0 |
| chr1:59156089-59158533 | 0 | 0 |
| chr1:59158603-59160801 | 0 | 0 |
| chr1:59160879-59165657 | 0 | 0 |
| | chr1:59127183-59131171 | chr1:59131303-59132710 |
| chr1:59125827-59126842 | 0 | 0 |
| chr1:59126899-59127078 | 0 | 0 |
| chr1:59127183-59131171 | 1 | 0 |
| chr1:59131303-59132710 | 0 | 1 |
| chr1:59132898-59133519 | 0 | 0 |
| chr1:59133593-59134102 | 0 | 0 |
| chr1:59133593-59134304 | 0 | 0 |
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| chr1:59134710-59137542 | 0 | 0 |
| chr1:59137630-59139245 | 0 | 0 |
| chr1:59139322-59141149 | 0 | 0 |
| chr1:59141252-59142598 | 0 | 0 |
| chr1:59142728-59147457 | 0 | 0 |
| chr1:59148217-59150825 | 0 | 0 |
| chr1:59150923-59154710 | 0 | 0 |
| chr1:59154788-59155898 | 0 | 0 |

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| chr1:59155921-59156012 | 0 | 0 |
| chr1:59156089-59158533 | 0 | 0 |
| chr1:59158603-59160801 | 0 | 0 |
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| chr1:59132898-59133519 | chr1:59133593-59134102 | |
| chr1:59125827-59126842 | 0 | 0 |
| chr1:59126899-59127078 | 0 | 0 |
| chr1:59127183-59131171 | 0 | 0 |
| chr1:59131303-59132710 | 0 | 0 |
| chr1:59132898-59133519 | 1 | 0 |
| chr1:59133593-59134102 | 0 | 1 |
| chr1:59133593-59134304 | 0 | 1 |
| chr1:59134238-59134656 | 0 | 0 |
| chr1:59134354-59134656 | 0 | 0 |
| chr1:59134710-59137542 | 0 | 0 |
| chr1:59137630-59139245 | 0 | 0 |
| chr1:59139322-59141149 | 0 | 0 |
| chr1:59141252-59142598 | 0 | 0 |
| chr1:59142728-59147457 | 0 | 0 |
| chr1:59148217-59150825 | 0 | 0 |
| chr1:59150923-59154710 | 0 | 0 |
| chr1:59154788-59155898 | 0 | 0 |
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| chr1:59156089-59158533 | 0 | 0 |
| chr1:59158603-59160801 | 0 | 0 |
| chr1:59160879-59165657 | 0 | 0 |
| chr1:59133593-59134304 | chr1:59134238-59134656 | |
| chr1:59125827-59126842 | 0 | 0 |
| chr1:59126899-59127078 | 0 | 0 |
| chr1:59127183-59131171 | 0 | 0 |
| chr1:59131303-59132710 | 0 | 0 |
| chr1:59132898-59133519 | 0 | 0 |
| chr1:59133593-59134102 | 1 | 0 |
| chr1:59133593-59134304 | 1 | 1 |
| chr1:59134238-59134656 | 1 | 1 |
| chr1:59134354-59134656 | 0 | 1 |
| chr1:59134710-59137542 | 0 | 0 |
| chr1:59137630-59139245 | 0 | 0 |
| chr1:59139322-59141149 | 0 | 0 |
| chr1:59141252-59142598 | 0 | 0 |
| chr1:59142728-59147457 | 0 | 0 |
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| chr1:59150923-59154710 | 0 | 0 |
| chr1:59154788-59155898 | 0 | 0 |
| chr1:59155921-59156012 | 0 | 0 |
| chr1:59156089-59158533 | 0 | 0 |
| chr1:59158603-59160801 | 0 | 0 |
| chr1:59160879-59165657 | 0 | 0 |
| chr1:59134354-59134656 | chr1:59134710-59137542 | |
| chr1:59125827-59126842 | 0 | 0 |
| chr1:59126899-59127078 | 0 | 0 |

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| chr1:59127183-59131171 | 0 | 0 |
| chr1:59131303-59132710 | 0 | 0 |
| chr1:59132898-59133519 | 0 | 0 |
| chr1:59133593-59134102 | 0 | 0 |
| chr1:59133593-59134304 | 0 | 0 |
| chr1:59134238-59134656 | 1 | 0 |
| chr1:59134354-59134656 | 1 | 0 |
| chr1:59134710-59137542 | 0 | 1 |
| chr1:59137630-59139245 | 0 | 0 |
| chr1:59139322-59141149 | 0 | 0 |
| chr1:59141252-59142598 | 0 | 0 |
| chr1:59142728-59147457 | 0 | 0 |
| chr1:59148217-59150825 | 0 | 0 |
| chr1:59150923-59154710 | 0 | 0 |
| chr1:59154788-59155898 | 0 | 0 |
| chr1:59155921-59156012 | 0 | 0 |
| chr1:59156089-59158533 | 0 | 0 |
| chr1:59158603-59160801 | 0 | 0 |
| chr1:59160879-59165657 | 0 | 0 |
| chr1:59137630-59139245 | chr1:59139322-59141149 | |
| chr1:59125827-59126842 | 0 | 0 |
| chr1:59126899-59127078 | 0 | 0 |
| chr1:59127183-59131171 | 0 | 0 |
| chr1:59131303-59132710 | 0 | 0 |
| chr1:59132898-59133519 | 0 | 0 |
| chr1:59133593-59134102 | 0 | 0 |
| chr1:59133593-59134304 | 0 | 0 |
| chr1:59134238-59134656 | 0 | 0 |
| chr1:59134354-59134656 | 0 | 0 |
| chr1:59134710-59137542 | 0 | 0 |
| chr1:59137630-59139245 | 1 | 0 |
| chr1:59139322-59141149 | 0 | 1 |
| chr1:59141252-59142598 | 0 | 0 |
| chr1:59142728-59147457 | 0 | 0 |
| chr1:59148217-59150825 | 0 | 0 |
| chr1:59150923-59154710 | 0 | 0 |
| chr1:59154788-59155898 | 0 | 0 |
| chr1:59155921-59156012 | 0 | 0 |
| chr1:59156089-59158533 | 0 | 0 |
| chr1:59158603-59160801 | 0 | 0 |
| chr1:59160879-59165657 | 0 | 0 |
| chr1:59141252-59142598 | chr1:59142728-59147457 | |
| chr1:59125827-59126842 | 0 | 0 |
| chr1:59126899-59127078 | 0 | 0 |
| chr1:59127183-59131171 | 0 | 0 |
| chr1:59131303-59132710 | 0 | 0 |
| chr1:59132898-59133519 | 0 | 0 |
| chr1:59133593-59134102 | 0 | 0 |
| chr1:59133593-59134304 | 0 | 0 |
| chr1:59134238-59134656 | 0 | 0 |
| chr1:59134354-59134656 | 0 | 0 |

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|---|---|---|
| chr1:59134710-59137542 | 0 | 0 |
| chr1:59137630-59139245 | 0 | 0 |
| chr1:59139322-59141149 | 0 | 0 |
| chr1:59141252-59142598 | 1 | 0 |
| chr1:59142728-59147457 | 0 | 1 |
| chr1:59148217-59150825 | 0 | 0 |
| chr1:59150923-59154710 | 0 | 0 |
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| chr1:59148217-59150825 chr1:59150923-59154710 | | |
| chr1:59125827-59126842 | 0 | 0 |
| chr1:59126899-59127078 | 0 | 0 |
| chr1:59127183-59131171 | 0 | 0 |
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| chr1:59132898-59133519 | 0 | 0 |
| chr1:59133593-59134102 | 0 | 0 |
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| chr1:59134710-59137542 | 0 | 0 |
| chr1:59137630-59139245 | 0 | 0 |
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| chr1:59142728-59147457 | 0 | 0 |
| chr1:59148217-59150825 | 1 | 0 |
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| chr1:59154788-59155898 | 0 | 0 |
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| chr1:59154788-59155898 chr1:59155921-59156012 | | |
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| chr1:59126899-59127078 | 0 | 0 |
| chr1:59127183-59131171 | 0 | 0 |
| chr1:59131303-59132710 | 0 | 0 |
| chr1:59132898-59133519 | 0 | 0 |
| chr1:59133593-59134102 | 0 | 0 |
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| chr1:59134238-59134656 | 0 | 0 |
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| chr1:59134710-59137542 | 0 | 0 |
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| chr1:59148217-59150825 | 0 | 0 |
| chr1:59150923-59154710 | 0 | 0 |

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| chr1:59154788-59155898 | 1 | 0 |
| chr1:59155921-59156012 | 0 | 1 |
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| chr1:59158603-59160801 | 0 | 0 |
| chr1:59160879-59165657 | 0 | 0 |
| chr1:59156089-59158533 | chr1:59158603-59160801 | |
| chr1:59125827-59126842 | 0 | 0 |
| chr1:59126899-59127078 | 0 | 0 |
| chr1:59127183-59131171 | 0 | 0 |
| chr1:59131303-59132710 | 0 | 0 |
| chr1:59132898-59133519 | 0 | 0 |
| chr1:59133593-59134102 | 0 | 0 |
| chr1:59133593-59134304 | 0 | 0 |
| chr1:59134238-59134656 | 0 | 0 |
| chr1:59134354-59134656 | 0 | 0 |
| chr1:59134710-59137542 | 0 | 0 |
| chr1:59137630-59139245 | 0 | 0 |
| chr1:59139322-59141149 | 0 | 0 |
| chr1:59141252-59142598 | 0 | 0 |
| chr1:59142728-59147457 | 0 | 0 |
| chr1:59148217-59150825 | 0 | 0 |
| chr1:59150923-59154710 | 0 | 0 |
| chr1:59154788-59155898 | 0 | 0 |
| chr1:59155921-59156012 | 0 | 0 |
| chr1:59156089-59158533 | 1 | 0 |
| chr1:59158603-59160801 | 0 | 1 |
| chr1:59160879-59165657 | 0 | 0 |
| chr1:59160879-59165657 | | |
| chr1:59125827-59126842 | 0 | |
| chr1:59126899-59127078 | 0 | |
| chr1:59127183-59131171 | 0 | |
| chr1:59131303-59132710 | 0 | |
| chr1:59132898-59133519 | 0 | |
| chr1:59133593-59134102 | 0 | |
| chr1:59133593-59134304 | 0 | |
| chr1:59134238-59134656 | 0 | |
| chr1:59134354-59134656 | 0 | |
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| chr1:59142728-59147457 | 0 | |
| chr1:59148217-59150825 | 0 | |
| chr1:59150923-59154710 | 0 | |
| chr1:59154788-59155898 | 0 | |
| chr1:59155921-59156012 | 0 | |
| chr1:59156089-59158533 | 0 | |
| chr1:59158603-59160801 | 0 | |
| chr1:59160879-59165657 | 1 | |

\$Rest\$NPHP4

| | chr1:5923465-5923950 | chr1:5924093-5924398 | chr1:5924577-5925162 |
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| chr1:5923465-5923950 | 1 | 0 | 0 |
| chr1:5924093-5924398 | 0 | 1 | 0 |
| chr1:5924577-5925162 | 0 | 0 | 1 |
| chr1:5925333-5926433 | 0 | 0 | 0 |
| chr1:5926518-5927090 | 0 | 0 | 0 |
| chr1:5927175-5927800 | 0 | 0 | 0 |
| chr1:5927956-5933312 | 0 | 0 | 0 |
| chr1:5933395-5934531 | 0 | 0 | 0 |
| chr1:5937358-5940174 | 0 | 0 | 0 |
| chr1:5940299-5947346 | 0 | 0 | 0 |
| chr1:5947526-5950928 | 0 | 0 | 0 |
| chr1:5951088-5964677 | 0 | 0 | 0 |
| chr1:5964864-5965352 | 0 | 0 | 0 |
| chr1:5965543-5965692 | 0 | 0 | 0 |
| chr1:5965843-5967175 | 0 | 0 | 0 |
| chr1:5967282-5969212 | 0 | 0 | 0 |
| chr1:5969273-5987709 | 0 | 0 | 0 |
| chr1:5987847-5993207 | 0 | 0 | 0 |
| chr1:5993389-6007164 | 0 | 0 | 0 |
| chr1:6007290-6008130 | 0 | 0 | 0 |
| chr1:6008311-6012760 | 0 | 0 | 0 |
| chr1:6012896-6021854 | 0 | 0 | 0 |
| chr1:6022009-6027359 | 0 | 0 | 0 |
| chr1:6027423-6029147 | 0 | 0 | 0 |
| chr1:6029319-6038330 | 0 | 0 | 0 |
| chr1:6038473-6046215 | 0 | 0 | 0 |
| chr1:6046387-6052304 | 0 | 0 | 0 |
| chr1:5934717-5934934 | 0 | 0 | 0 |
| chr1:5965840-5967175 | 0 | 0 | 0 |
| chr1:5936583-5937153 | 0 | 0 | 0 |
| chr1:5937358-5939406 | 0 | 0 | 0 |
| chr1:5939692-5940174 | 0 | 0 | 0 |
| | chr1:5925333-5926433 | chr1:5926518-5927090 | chr1:5927175-5927800 |
| chr1:5923465-5923950 | 0 | 0 | 0 |
| chr1:5924093-5924398 | 0 | 0 | 0 |
| chr1:5924577-5925162 | 0 | 0 | 0 |
| chr1:5925333-5926433 | 1 | 0 | 0 |
| chr1:5926518-5927090 | 0 | 1 | 0 |
| chr1:5927175-5927800 | 0 | 0 | 1 |
| chr1:5927956-5933312 | 0 | 0 | 0 |
| chr1:5933395-5934531 | 0 | 0 | 0 |
| chr1:5937358-5940174 | 0 | 0 | 0 |
| chr1:5940299-5947346 | 0 | 0 | 0 |
| chr1:5947526-5950928 | 0 | 0 | 0 |
| chr1:5951088-5964677 | 0 | 0 | 0 |
| chr1:5964864-5965352 | 0 | 0 | 0 |
| chr1:5965543-5965692 | 0 | 0 | 0 |
| chr1:5965843-5967175 | 0 | 0 | 0 |
| chr1:5967282-5969212 | 0 | 0 | 0 |
| chr1:5969273-5987709 | 0 | 0 | 0 |

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| chr1:5987847-5993207 | 0 | 0 | 0 |
| chr1:5993389-6007164 | 0 | 0 | 0 |
| chr1:6007290-6008130 | 0 | 0 | 0 |
| chr1:6008311-6012760 | 0 | 0 | 0 |
| chr1:6012896-6021854 | 0 | 0 | 0 |
| chr1:6022009-6027359 | 0 | 0 | 0 |
| chr1:6027423-6029147 | 0 | 0 | 0 |
| chr1:6029319-6038330 | 0 | 0 | 0 |
| chr1:6038473-6046215 | 0 | 0 | 0 |
| chr1:6046387-6052304 | 0 | 0 | 0 |
| chr1:5934717-5934934 | 0 | 0 | 0 |
| chr1:5965840-5967175 | 0 | 0 | 0 |
| chr1:5936583-5937153 | 0 | 0 | 0 |
| chr1:5937358-5939406 | 0 | 0 | 0 |
| chr1:5939692-5940174 | 0 | 0 | 0 |
| chr1:5927956-5933312 | chr1:5933395-5934531 | chr1:5937358-5940174 | |
| chr1:5923465-5923950 | 0 | 0 | 0 |
| chr1:5924093-5924398 | 0 | 0 | 0 |
| chr1:5924577-5925162 | 0 | 0 | 0 |
| chr1:5925333-5926433 | 0 | 0 | 0 |
| chr1:5926518-5927090 | 0 | 0 | 0 |
| chr1:5927175-5927800 | 0 | 0 | 0 |
| chr1:5927956-5933312 | 1 | 0 | 0 |
| chr1:5933395-5934531 | 0 | 1 | 0 |
| chr1:5937358-5940174 | 0 | 0 | 1 |
| chr1:5940299-5947346 | 0 | 0 | 0 |
| chr1:5947526-5950928 | 0 | 0 | 0 |
| chr1:5951088-5964677 | 0 | 0 | 0 |
| chr1:5964864-5965352 | 0 | 0 | 0 |
| chr1:5965543-5965692 | 0 | 0 | 0 |
| chr1:5965843-5967175 | 0 | 0 | 0 |
| chr1:5967282-5969212 | 0 | 0 | 0 |
| chr1:5969273-5987709 | 0 | 0 | 0 |
| chr1:5987847-5993207 | 0 | 0 | 0 |
| chr1:5993389-6007164 | 0 | 0 | 0 |
| chr1:6007290-6008130 | 0 | 0 | 0 |
| chr1:6008311-6012760 | 0 | 0 | 0 |
| chr1:6012896-6021854 | 0 | 0 | 0 |
| chr1:6022009-6027359 | 0 | 0 | 0 |
| chr1:6027423-6029147 | 0 | 0 | 0 |
| chr1:6029319-6038330 | 0 | 0 | 0 |
| chr1:6038473-6046215 | 0 | 0 | 0 |
| chr1:6046387-6052304 | 0 | 0 | 0 |
| chr1:5934717-5934934 | 0 | 0 | 0 |
| chr1:5965840-5967175 | 0 | 0 | 0 |
| chr1:5936583-5937153 | 0 | 0 | 0 |
| chr1:5937358-5939406 | 0 | 0 | 1 |
| chr1:5939692-5940174 | 0 | 0 | 1 |
| chr1:5940299-5947346 | chr1:5947526-5950928 | chr1:5951088-5964677 | |
| chr1:5923465-5923950 | 0 | 0 | 0 |
| chr1:5924093-5924398 | 0 | 0 | 0 |

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|----------------------|----------------------|----------------------|---|
| chr1:5924577-5925162 | 0 | 0 | 0 |
| chr1:5925333-5926433 | 0 | 0 | 0 |
| chr1:5926518-5927090 | 0 | 0 | 0 |
| chr1:5927175-5927800 | 0 | 0 | 0 |
| chr1:5927956-5933312 | 0 | 0 | 0 |
| chr1:5933395-5934531 | 0 | 0 | 0 |
| chr1:5937358-5940174 | 0 | 0 | 0 |
| chr1:5940299-5947346 | 1 | 0 | 0 |
| chr1:5947526-5950928 | 0 | 1 | 0 |
| chr1:5951088-5964677 | 0 | 0 | 1 |
| chr1:5964864-5965352 | 0 | 0 | 0 |
| chr1:5965543-5965692 | 0 | 0 | 0 |
| chr1:5965843-5967175 | 0 | 0 | 0 |
| chr1:5967282-5969212 | 0 | 0 | 0 |
| chr1:5969273-5987709 | 0 | 0 | 0 |
| chr1:5987847-5993207 | 0 | 0 | 0 |
| chr1:5993389-6007164 | 0 | 0 | 0 |
| chr1:6007290-6008130 | 0 | 0 | 0 |
| chr1:6008311-6012760 | 0 | 0 | 0 |
| chr1:6012896-6021854 | 0 | 0 | 0 |
| chr1:6022009-6027359 | 0 | 0 | 0 |
| chr1:6027423-6029147 | 0 | 0 | 0 |
| chr1:6029319-6038330 | 0 | 0 | 0 |
| chr1:6038473-6046215 | 0 | 0 | 0 |
| chr1:6046387-6052304 | 0 | 0 | 0 |
| chr1:5934717-5934934 | 0 | 0 | 0 |
| chr1:5965840-5967175 | 0 | 0 | 0 |
| chr1:5936583-5937153 | 0 | 0 | 0 |
| chr1:5937358-5939406 | 0 | 0 | 0 |
| chr1:5939692-5940174 | 0 | 0 | 0 |
| chr1:5964864-5965352 | chr1:5965543-5965692 | chr1:5965843-5967175 | |
| chr1:5923465-5923950 | 0 | 0 | 0 |
| chr1:5924093-5924398 | 0 | 0 | 0 |
| chr1:5924577-5925162 | 0 | 0 | 0 |
| chr1:5925333-5926433 | 0 | 0 | 0 |
| chr1:5926518-5927090 | 0 | 0 | 0 |
| chr1:5927175-5927800 | 0 | 0 | 0 |
| chr1:5927956-5933312 | 0 | 0 | 0 |
| chr1:5933395-5934531 | 0 | 0 | 0 |
| chr1:5937358-5940174 | 0 | 0 | 0 |
| chr1:5940299-5947346 | 0 | 0 | 0 |
| chr1:5947526-5950928 | 0 | 0 | 0 |
| chr1:5951088-5964677 | 0 | 0 | 0 |
| chr1:5964864-5965352 | 1 | 0 | 0 |
| chr1:5965543-5965692 | 0 | 1 | 0 |
| chr1:5965843-5967175 | 0 | 0 | 1 |
| chr1:5967282-5969212 | 0 | 0 | 0 |
| chr1:5969273-5987709 | 0 | 0 | 0 |
| chr1:5987847-5993207 | 0 | 0 | 0 |
| chr1:5993389-6007164 | 0 | 0 | 0 |
| chr1:6007290-6008130 | 0 | 0 | 0 |

| | | | |
|----------------------|----------------------|----------------------|---|
| chr1:6008311-6012760 | 0 | 0 | 0 |
| chr1:6012896-6021854 | 0 | 0 | 0 |
| chr1:6022009-6027359 | 0 | 0 | 0 |
| chr1:6027423-6029147 | 0 | 0 | 0 |
| chr1:6029319-6038330 | 0 | 0 | 0 |
| chr1:6038473-6046215 | 0 | 0 | 0 |
| chr1:6046387-6052304 | 0 | 0 | 0 |
| chr1:5934717-5934934 | 0 | 0 | 0 |
| chr1:5965840-5967175 | 0 | 0 | 1 |
| chr1:5936583-5937153 | 0 | 0 | 0 |
| chr1:5937358-5939406 | 0 | 0 | 0 |
| chr1:5939692-5940174 | 0 | 0 | 0 |
| chr1:5967282-5969212 | chr1:5969273-5987709 | chr1:5987847-5993207 | |
| chr1:5923465-5923950 | 0 | 0 | 0 |
| chr1:5924093-5924398 | 0 | 0 | 0 |
| chr1:5924577-5925162 | 0 | 0 | 0 |
| chr1:5925333-5926433 | 0 | 0 | 0 |
| chr1:5926518-5927090 | 0 | 0 | 0 |
| chr1:5927175-5927800 | 0 | 0 | 0 |
| chr1:5927956-5933312 | 0 | 0 | 0 |
| chr1:5933395-5934531 | 0 | 0 | 0 |
| chr1:5937358-5940174 | 0 | 0 | 0 |
| chr1:5940299-5947346 | 0 | 0 | 0 |
| chr1:5947526-5950928 | 0 | 0 | 0 |
| chr1:5951088-5964677 | 0 | 0 | 0 |
| chr1:5964864-5965352 | 0 | 0 | 0 |
| chr1:5965543-5965692 | 0 | 0 | 0 |
| chr1:5965843-5967175 | 0 | 0 | 0 |
| chr1:5967282-5969212 | 1 | 0 | 0 |
| chr1:5969273-5987709 | 0 | 1 | 0 |
| chr1:5987847-5993207 | 0 | 0 | 1 |
| chr1:5993389-6007164 | 0 | 0 | 0 |
| chr1:6007290-6008130 | 0 | 0 | 0 |
| chr1:6008311-6012760 | 0 | 0 | 0 |
| chr1:6012896-6021854 | 0 | 0 | 0 |
| chr1:6022009-6027359 | 0 | 0 | 0 |
| chr1:6027423-6029147 | 0 | 0 | 0 |
| chr1:6029319-6038330 | 0 | 0 | 0 |
| chr1:6038473-6046215 | 0 | 0 | 0 |
| chr1:6046387-6052304 | 0 | 0 | 0 |
| chr1:5934717-5934934 | 0 | 0 | 0 |
| chr1:5965840-5967175 | 0 | 0 | 0 |
| chr1:5936583-5937153 | 0 | 0 | 0 |
| chr1:5937358-5939406 | 0 | 0 | 0 |
| chr1:5939692-5940174 | 0 | 0 | 0 |
| chr1:5993389-6007164 | chr1:6007290-6008130 | chr1:6008311-6012760 | |
| chr1:5923465-5923950 | 0 | 0 | 0 |
| chr1:5924093-5924398 | 0 | 0 | 0 |
| chr1:5924577-5925162 | 0 | 0 | 0 |
| chr1:5925333-5926433 | 0 | 0 | 0 |
| chr1:5926518-5927090 | 0 | 0 | 0 |

| | | | |
|----------------------|----------------------|----------------------|---|
| chr1:5927175-5927800 | 0 | 0 | 0 |
| chr1:5927956-5933312 | 0 | 0 | 0 |
| chr1:5933395-5934531 | 0 | 0 | 0 |
| chr1:5937358-5940174 | 0 | 0 | 0 |
| chr1:5940299-5947346 | 0 | 0 | 0 |
| chr1:5947526-5950928 | 0 | 0 | 0 |
| chr1:5951088-5964677 | 0 | 0 | 0 |
| chr1:5964864-5965352 | 0 | 0 | 0 |
| chr1:5965543-5965692 | 0 | 0 | 0 |
| chr1:5965843-5967175 | 0 | 0 | 0 |
| chr1:5967282-5969212 | 0 | 0 | 0 |
| chr1:5969273-5987709 | 0 | 0 | 0 |
| chr1:5987847-5993207 | 0 | 0 | 0 |
| chr1:5993389-6007164 | 1 | 0 | 0 |
| chr1:6007290-6008130 | 0 | 1 | 0 |
| chr1:6008311-6012760 | 0 | 0 | 1 |
| chr1:6012896-6021854 | 0 | 0 | 0 |
| chr1:6022009-6027359 | 0 | 0 | 0 |
| chr1:6027423-6029147 | 0 | 0 | 0 |
| chr1:6029319-6038330 | 0 | 0 | 0 |
| chr1:6038473-6046215 | 0 | 0 | 0 |
| chr1:6046387-6052304 | 0 | 0 | 0 |
| chr1:5934717-5934934 | 0 | 0 | 0 |
| chr1:5965840-5967175 | 0 | 0 | 0 |
| chr1:5936583-5937153 | 0 | 0 | 0 |
| chr1:5937358-5939406 | 0 | 0 | 0 |
| chr1:5939692-5940174 | 0 | 0 | 0 |
| chr1:6012896-6021854 | chr1:6022009-6027359 | chr1:6027423-6029147 | |
| chr1:5923465-5923950 | 0 | 0 | 0 |
| chr1:5924093-5924398 | 0 | 0 | 0 |
| chr1:5924577-5925162 | 0 | 0 | 0 |
| chr1:5925333-5926433 | 0 | 0 | 0 |
| chr1:5926518-5927090 | 0 | 0 | 0 |
| chr1:5927175-5927800 | 0 | 0 | 0 |
| chr1:5927956-5933312 | 0 | 0 | 0 |
| chr1:5933395-5934531 | 0 | 0 | 0 |
| chr1:5937358-5940174 | 0 | 0 | 0 |
| chr1:5940299-5947346 | 0 | 0 | 0 |
| chr1:5947526-5950928 | 0 | 0 | 0 |
| chr1:5951088-5964677 | 0 | 0 | 0 |
| chr1:5964864-5965352 | 0 | 0 | 0 |
| chr1:5965543-5965692 | 0 | 0 | 0 |
| chr1:5965843-5967175 | 0 | 0 | 0 |
| chr1:5967282-5969212 | 0 | 0 | 0 |
| chr1:5969273-5987709 | 0 | 0 | 0 |
| chr1:5987847-5993207 | 0 | 0 | 0 |
| chr1:5993389-6007164 | 0 | 0 | 0 |
| chr1:6007290-6008130 | 0 | 0 | 0 |
| chr1:6008311-6012760 | 0 | 0 | 0 |
| chr1:6012896-6021854 | 1 | 0 | 0 |
| chr1:6022009-6027359 | 0 | 1 | 0 |

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|----------------------|---|---|---|
| chr1:6027423-6029147 | 0 | 0 | 1 |
| chr1:6029319-6038330 | 0 | 0 | 0 |
| chr1:6038473-6046215 | 0 | 0 | 0 |
| chr1:6046387-6052304 | 0 | 0 | 0 |
| chr1:5934717-5934934 | 0 | 0 | 0 |
| chr1:5965840-5967175 | 0 | 0 | 0 |
| chr1:5936583-5937153 | 0 | 0 | 0 |
| chr1:5937358-5939406 | 0 | 0 | 0 |
| chr1:5939692-5940174 | 0 | 0 | 0 |
| chr1:5923465-5923950 | 0 | 0 | 0 |
| chr1:5924093-5924398 | 0 | 0 | 0 |
| chr1:5924577-5925162 | 0 | 0 | 0 |
| chr1:5925333-5926433 | 0 | 0 | 0 |
| chr1:5926518-5927090 | 0 | 0 | 0 |
| chr1:5927175-5927800 | 0 | 0 | 0 |
| chr1:5927956-5933312 | 0 | 0 | 0 |
| chr1:5933395-5934531 | 0 | 0 | 0 |
| chr1:5937358-5940174 | 0 | 0 | 0 |
| chr1:5940299-5947346 | 0 | 0 | 0 |
| chr1:5947526-5950928 | 0 | 0 | 0 |
| chr1:5951088-5964677 | 0 | 0 | 0 |
| chr1:5964864-5965352 | 0 | 0 | 0 |
| chr1:5965543-5965692 | 0 | 0 | 0 |
| chr1:5965843-5967175 | 0 | 0 | 0 |
| chr1:5967282-5969212 | 0 | 0 | 0 |
| chr1:5969273-5987709 | 0 | 0 | 0 |
| chr1:5987847-5993207 | 0 | 0 | 0 |
| chr1:5993389-6007164 | 0 | 0 | 0 |
| chr1:6007290-6008130 | 0 | 0 | 0 |
| chr1:6008311-6012760 | 0 | 0 | 0 |
| chr1:6012896-6021854 | 0 | 0 | 0 |
| chr1:6022009-6027359 | 0 | 0 | 0 |
| chr1:6027423-6029147 | 0 | 0 | 0 |
| chr1:6029319-6038330 | 1 | 0 | 0 |
| chr1:6038473-6046215 | 0 | 1 | 0 |
| chr1:6046387-6052304 | 0 | 0 | 1 |
| chr1:5934717-5934934 | 0 | 0 | 0 |
| chr1:5965840-5967175 | 0 | 0 | 0 |
| chr1:5936583-5937153 | 0 | 0 | 0 |
| chr1:5937358-5939406 | 0 | 0 | 0 |
| chr1:5939692-5940174 | 0 | 0 | 0 |
| chr1:5923465-5923950 | 0 | 0 | 0 |
| chr1:5924093-5924398 | 0 | 0 | 0 |
| chr1:5924577-5925162 | 0 | 0 | 0 |
| chr1:5925333-5926433 | 0 | 0 | 0 |
| chr1:5926518-5927090 | 0 | 0 | 0 |
| chr1:5927175-5927800 | 0 | 0 | 0 |
| chr1:5927956-5933312 | 0 | 0 | 0 |
| chr1:5933395-5934531 | 0 | 0 | 0 |

| | | | |
|---|---|---|---|
| chr1:5937358-5940174 | 0 | 0 | 0 |
| chr1:5940299-5947346 | 0 | 0 | 0 |
| chr1:5947526-5950928 | 0 | 0 | 0 |
| chr1:5951088-5964677 | 0 | 0 | 0 |
| chr1:5964864-5965352 | 0 | 0 | 0 |
| chr1:5965543-5965692 | 0 | 0 | 0 |
| chr1:5965843-5967175 | 0 | 1 | 0 |
| chr1:5967282-5969212 | 0 | 0 | 0 |
| chr1:5969273-5987709 | 0 | 0 | 0 |
| chr1:5987847-5993207 | 0 | 0 | 0 |
| chr1:5993389-6007164 | 0 | 0 | 0 |
| chr1:6007290-6008130 | 0 | 0 | 0 |
| chr1:6008311-6012760 | 0 | 0 | 0 |
| chr1:6012896-6021854 | 0 | 0 | 0 |
| chr1:6022009-6027359 | 0 | 0 | 0 |
| chr1:6027423-6029147 | 0 | 0 | 0 |
| chr1:6029319-6038330 | 0 | 0 | 0 |
| chr1:6038473-6046215 | 0 | 0 | 0 |
| chr1:6046387-6052304 | 0 | 0 | 0 |
| chr1:5934717-5934934 | 1 | 0 | 0 |
| chr1:5965840-5967175 | 0 | 1 | 0 |
| chr1:5936583-5937153 | 0 | 0 | 1 |
| chr1:5937358-5939406 | 0 | 0 | 0 |
| chr1:5939692-5940174 | 0 | 0 | 0 |
| chr1:5937358-5939406 chr1:5939692-5940174 | | | |
| chr1:5923465-5923950 | 0 | 0 | |
| chr1:5924093-5924398 | 0 | 0 | |
| chr1:5924577-5925162 | 0 | 0 | |
| chr1:5925333-5926433 | 0 | 0 | |
| chr1:5926518-5927090 | 0 | 0 | |
| chr1:5927175-5927800 | 0 | 0 | |
| chr1:5927956-5933312 | 0 | 0 | |
| chr1:5933395-5934531 | 0 | 0 | |
| chr1:5937358-5940174 | 1 | 1 | |
| chr1:5940299-5947346 | 0 | 0 | |
| chr1:5947526-5950928 | 0 | 0 | |
| chr1:5951088-5964677 | 0 | 0 | |
| chr1:5964864-5965352 | 0 | 0 | |
| chr1:5965543-5965692 | 0 | 0 | |
| chr1:5965843-5967175 | 0 | 0 | |
| chr1:5967282-5969212 | 0 | 0 | |
| chr1:5969273-5987709 | 0 | 0 | |
| chr1:5987847-5993207 | 0 | 0 | |
| chr1:5993389-6007164 | 0 | 0 | |
| chr1:6007290-6008130 | 0 | 0 | |
| chr1:6008311-6012760 | 0 | 0 | |
| chr1:6012896-6021854 | 0 | 0 | |
| chr1:6022009-6027359 | 0 | 0 | |
| chr1:6027423-6029147 | 0 | 0 | |
| chr1:6029319-6038330 | 0 | 0 | |
| chr1:6038473-6046215 | 0 | 0 | |

| | | |
|--------------------------|--------------------------|--------------------------|
| chr1:6046387-6052304 | 0 | 0 |
| chr1:5934717-5934934 | 0 | 0 |
| chr1:5965840-5967175 | 0 | 0 |
| chr1:5936583-5937153 | 0 | 0 |
| chr1:5937358-5939406 | 1 | 0 |
| chr1:5939692-5940174 | 0 | 1 |
| \$Rest\$PEX14 | | |
| | chr1:10637247-10637871 | chr1:10659423-10678389 |
| chr1:10637247-10637871 | 1 | 0 |
| chr1:10659423-10678389 | 0 | 1 |
| chr1:10678474-10683076 | 0 | 0 |
| chr1:10683178-10684397 | 0 | 0 |
| chr1:10684494-10687329 | 0 | 0 |
| chr1:10687420-10689588 | 0 | 0 |
| chr1:10596354-10659295 | 1 | 0 |
| chr1:10596354-10678389 | 1 | 1 |
| | chr1:10678474-10683076 | chr1:10683178-10684397 |
| chr1:10637247-10637871 | 0 | 0 |
| chr1:10659423-10678389 | 0 | 0 |
| chr1:10678474-10683076 | 1 | 0 |
| chr1:10683178-10684397 | 0 | 1 |
| chr1:10684494-10687329 | 0 | 0 |
| chr1:10687420-10689588 | 0 | 0 |
| chr1:10596354-10659295 | 0 | 0 |
| chr1:10596354-10678389 | 0 | 0 |
| | chr1:10684494-10687329 | chr1:10687420-10689588 |
| chr1:10637247-10637871 | 0 | 0 |
| chr1:10659423-10678389 | 0 | 0 |
| chr1:10678474-10683076 | 0 | 0 |
| chr1:10683178-10684397 | 0 | 0 |
| chr1:10684494-10687329 | 1 | 0 |
| chr1:10687420-10689588 | 0 | 1 |
| chr1:10596354-10659295 | 0 | 0 |
| chr1:10596354-10678389 | 0 | 0 |
| | chr1:10596354-10659295 | chr1:10596354-10678389 |
| chr1:10637247-10637871 | 1 | 1 |
| chr1:10659423-10678389 | 0 | 1 |
| chr1:10678474-10683076 | 0 | 0 |
| chr1:10683178-10684397 | 0 | 0 |
| chr1:10684494-10687329 | 0 | 0 |
| chr1:10687420-10689588 | 0 | 0 |
| chr1:10596354-10659295 | 1 | 1 |
| chr1:10596354-10678389 | 1 | 1 |
| \$Rest\$PIP5K1A | | |
| | chr1:151171557-151196721 | chr1:151171557-151196724 |
| chr1:151171557-151196721 | 1 | 1 |
| chr1:151171557-151196724 | 1 | 1 |
| chr1:151196755-151199796 | 0 | 0 |
| chr1:151199876-151204147 | 0 | 0 |

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| chr1:151204277-151204724 | 0 | 0 |
| chr1:151204841-151205027 | 0 | 0 |
| chr1:151205179-151206673 | 0 | 0 |
| chr1:151206972-151209034 | 0 | 0 |
| chr1:151209239-151210658 | 0 | 0 |
| chr1:151209239-151211606 | 0 | 0 |
| chr1:151210741-151211606 | 0 | 0 |
| chr1:151211654-151212431 | 0 | 0 |
| chr1:151212515-151214599 | 0 | 0 |
| chr1:151212515-151219396 | 0 | 0 |
| chr1:151214745-151214914 | 0 | 0 |
| chr1:151215043-151219396 | 0 | 0 |
| chr1:151219441-151220339 | 0 | 0 |
| chr1:151196755-151196847 | 0 | 0 |
| chr1:151196882-151199796 | 0 | 0 |
| chr1:151212515-151214914 | 0 | 0 |
| chr1:151196755-151199796 | chr1:151199876-151204147 | |
| chr1:151171557-151196721 | 0 | 0 |
| chr1:151171557-151196724 | 0 | 0 |
| chr1:151196755-151199796 | 1 | 0 |
| chr1:151199876-151204147 | 0 | 1 |
| chr1:151204277-151204724 | 0 | 0 |
| chr1:151204841-151205027 | 0 | 0 |
| chr1:151205179-151206673 | 0 | 0 |
| chr1:151206972-151209034 | 0 | 0 |
| chr1:151209239-151210658 | 0 | 0 |
| chr1:151209239-151211606 | 0 | 0 |
| chr1:151210741-151211606 | 0 | 0 |
| chr1:151211654-151212431 | 0 | 0 |
| chr1:151212515-151214599 | 0 | 0 |
| chr1:151212515-151219396 | 0 | 0 |
| chr1:151214745-151214914 | 0 | 0 |
| chr1:151215043-151219396 | 0 | 0 |
| chr1:151219441-151220339 | 0 | 0 |
| chr1:151196755-151196847 | 1 | 0 |
| chr1:151196882-151199796 | 1 | 0 |
| chr1:151212515-151214914 | 0 | 0 |
| chr1:151204277-151204724 | chr1:151204841-151205027 | |
| chr1:151171557-151196721 | 0 | 0 |
| chr1:151171557-151196724 | 0 | 0 |
| chr1:151196755-151199796 | 0 | 0 |
| chr1:151199876-151204147 | 0 | 0 |
| chr1:151204277-151204724 | 1 | 0 |
| chr1:151204841-151205027 | 0 | 1 |
| chr1:151205179-151206673 | 0 | 0 |
| chr1:151206972-151209034 | 0 | 0 |
| chr1:151209239-151210658 | 0 | 0 |
| chr1:151209239-151211606 | 0 | 0 |
| chr1:151210741-151211606 | 0 | 0 |
| chr1:151211654-151212431 | 0 | 0 |
| chr1:151212515-151214599 | 0 | 0 |

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| chr1:151212515-151219396 | 0 | 0 |
| chr1:151214745-151214914 | 0 | 0 |
| chr1:151215043-151219396 | 0 | 0 |
| chr1:151219441-151220339 | 0 | 0 |
| chr1:151196755-151196847 | 0 | 0 |
| chr1:151196882-151199796 | 0 | 0 |
| chr1:151212515-151214914 | 0 | 0 |
| chr1:151205179-151206673 | chr1:151206972-151209034 | |
| chr1:151171557-151196721 | 0 | 0 |
| chr1:151171557-151196724 | 0 | 0 |
| chr1:151196755-151199796 | 0 | 0 |
| chr1:151199876-151204147 | 0 | 0 |
| chr1:151204277-151204724 | 0 | 0 |
| chr1:151204841-151205027 | 0 | 0 |
| chr1:151205179-151206673 | 1 | 0 |
| chr1:151206972-151209034 | 0 | 1 |
| chr1:151209239-151210658 | 0 | 0 |
| chr1:151209239-151211606 | 0 | 0 |
| chr1:151210741-151211606 | 0 | 0 |
| chr1:151211654-151212431 | 0 | 0 |
| chr1:151212515-151214599 | 0 | 0 |
| chr1:151212515-151219396 | 0 | 0 |
| chr1:151214745-151214914 | 0 | 0 |
| chr1:151215043-151219396 | 0 | 0 |
| chr1:151219441-151220339 | 0 | 0 |
| chr1:151196755-151196847 | 0 | 0 |
| chr1:151196882-151199796 | 0 | 0 |
| chr1:151212515-151214914 | 0 | 0 |
| chr1:151209239-151210658 | chr1:151209239-151211606 | |
| chr1:151171557-151196721 | 0 | 0 |
| chr1:151171557-151196724 | 0 | 0 |
| chr1:151196755-151199796 | 0 | 0 |
| chr1:151199876-151204147 | 0 | 0 |
| chr1:151204277-151204724 | 0 | 0 |
| chr1:151204841-151205027 | 0 | 0 |
| chr1:151205179-151206673 | 0 | 0 |
| chr1:151206972-151209034 | 0 | 0 |
| chr1:151209239-151210658 | 1 | 1 |
| chr1:151209239-151211606 | 1 | 1 |
| chr1:151210741-151211606 | 0 | 1 |
| chr1:151211654-151212431 | 0 | 0 |
| chr1:151212515-151214599 | 0 | 0 |
| chr1:151212515-151219396 | 0 | 0 |
| chr1:151214745-151214914 | 0 | 0 |
| chr1:151215043-151219396 | 0 | 0 |
| chr1:151219441-151220339 | 0 | 0 |
| chr1:151196755-151196847 | 0 | 0 |
| chr1:151196882-151199796 | 0 | 0 |
| chr1:151212515-151214914 | 0 | 0 |
| chr1:151210741-151211606 | chr1:151211654-151212431 | |
| chr1:151171557-151196721 | 0 | 0 |

| | | |
|--------------------------|--------------------------|---|
| chr1:151171557-151196724 | 0 | 0 |
| chr1:151196755-151199796 | 0 | 0 |
| chr1:151199876-151204147 | 0 | 0 |
| chr1:151204277-151204724 | 0 | 0 |
| chr1:151204841-151205027 | 0 | 0 |
| chr1:151205179-151206673 | 0 | 0 |
| chr1:151206972-151209034 | 0 | 0 |
| chr1:151209239-151210658 | 0 | 0 |
| chr1:151209239-151211606 | 1 | 0 |
| chr1:151210741-151211606 | 1 | 0 |
| chr1:151211654-151212431 | 0 | 1 |
| chr1:151212515-151214599 | 0 | 0 |
| chr1:151212515-151219396 | 0 | 0 |
| chr1:151214745-151214914 | 0 | 0 |
| chr1:151215043-151219396 | 0 | 0 |
| chr1:151219441-151220339 | 0 | 0 |
| chr1:151196755-151196847 | 0 | 0 |
| chr1:151196882-151199796 | 0 | 0 |
| chr1:151212515-151214914 | 0 | 0 |
| chr1:151212515-151214599 | chr1:151212515-151219396 | |
| chr1:151171557-151196721 | 0 | 0 |
| chr1:151171557-151196724 | 0 | 0 |
| chr1:151196755-151199796 | 0 | 0 |
| chr1:151199876-151204147 | 0 | 0 |
| chr1:151204277-151204724 | 0 | 0 |
| chr1:151204841-151205027 | 0 | 0 |
| chr1:151205179-151206673 | 0 | 0 |
| chr1:151206972-151209034 | 0 | 0 |
| chr1:151209239-151210658 | 0 | 0 |
| chr1:151209239-151211606 | 0 | 0 |
| chr1:151210741-151211606 | 0 | 0 |
| chr1:151211654-151212431 | 0 | 0 |
| chr1:151212515-151214599 | 1 | 1 |
| chr1:151212515-151219396 | 1 | 1 |
| chr1:151214745-151214914 | 0 | 1 |
| chr1:151215043-151219396 | 0 | 1 |
| chr1:151219441-151220339 | 0 | 0 |
| chr1:151196755-151196847 | 0 | 0 |
| chr1:151196882-151199796 | 0 | 0 |
| chr1:151212515-151214914 | 1 | 1 |
| chr1:151214745-151214914 | chr1:151215043-151219396 | |
| chr1:151171557-151196721 | 0 | 0 |
| chr1:151171557-151196724 | 0 | 0 |
| chr1:151196755-151199796 | 0 | 0 |
| chr1:151199876-151204147 | 0 | 0 |
| chr1:151204277-151204724 | 0 | 0 |
| chr1:151204841-151205027 | 0 | 0 |
| chr1:151205179-151206673 | 0 | 0 |
| chr1:151206972-151209034 | 0 | 0 |
| chr1:151209239-151210658 | 0 | 0 |
| chr1:151209239-151211606 | 0 | 0 |

| | | |
|--------------------------|--------------------------|---|
| chr1:151210741-151211606 | 0 | 0 |
| chr1:151211654-151212431 | 0 | 0 |
| chr1:151212515-151214599 | 0 | 0 |
| chr1:151212515-151219396 | 1 | 1 |
| chr1:151214745-151214914 | 1 | 0 |
| chr1:151215043-151219396 | 0 | 1 |
| chr1:151219441-151220339 | 0 | 0 |
| chr1:151196755-151196847 | 0 | 0 |
| chr1:151196882-151199796 | 0 | 0 |
| chr1:151212515-151214914 | 1 | 0 |
| chr1:151219441-151220339 | chr1:151196755-151196847 | |
| chr1:151171557-151196721 | 0 | 0 |
| chr1:151171557-151196724 | 0 | 0 |
| chr1:151196755-151199796 | 0 | 1 |
| chr1:151199876-151204147 | 0 | 0 |
| chr1:151204277-151204724 | 0 | 0 |
| chr1:151204841-151205027 | 0 | 0 |
| chr1:151205179-151206673 | 0 | 0 |
| chr1:151206972-151209034 | 0 | 0 |
| chr1:151209239-151210658 | 0 | 0 |
| chr1:151209239-151211606 | 0 | 0 |
| chr1:151210741-151211606 | 0 | 0 |
| chr1:151211654-151212431 | 0 | 0 |
| chr1:151212515-151214599 | 0 | 0 |
| chr1:151212515-151219396 | 0 | 0 |
| chr1:151214745-151214914 | 0 | 0 |
| chr1:151215043-151219396 | 0 | 0 |
| chr1:151219441-151220339 | 1 | 0 |
| chr1:151196755-151196847 | 0 | 1 |
| chr1:151196882-151199796 | 0 | 0 |
| chr1:151212515-151214914 | 0 | 0 |
| chr1:151196882-151199796 | chr1:151212515-151214914 | |
| chr1:151171557-151196721 | 0 | 0 |
| chr1:151171557-151196724 | 0 | 0 |
| chr1:151196755-151199796 | 1 | 0 |
| chr1:151199876-151204147 | 0 | 0 |
| chr1:151204277-151204724 | 0 | 0 |
| chr1:151204841-151205027 | 0 | 0 |
| chr1:151205179-151206673 | 0 | 0 |
| chr1:151206972-151209034 | 0 | 0 |
| chr1:151209239-151210658 | 0 | 0 |
| chr1:151209239-151211606 | 0 | 0 |
| chr1:151210741-151211606 | 0 | 0 |
| chr1:151211654-151212431 | 0 | 0 |
| chr1:151212515-151214599 | 0 | 1 |
| chr1:151212515-151219396 | 0 | 1 |
| chr1:151214745-151214914 | 0 | 1 |
| chr1:151215043-151219396 | 0 | 0 |
| chr1:151219441-151220339 | 0 | 0 |
| chr1:151196755-151196847 | 0 | 0 |
| chr1:151196882-151199796 | 1 | 0 |

chr1:151212515-151214914

0

1

\$Rest\$PSMB2

| | | |
|------------------------|------------------------|------------------------|
| | chr1:36068975-36070834 | chr1:36070883-36074847 |
| chr1:36068975-36070834 | 1 | 0 |
| chr1:36070883-36074847 | 0 | 1 |
| chr1:36075009-36096875 | 0 | 0 |
| chr1:36096945-36101911 | 0 | 0 |
| chr1:36102033-36106943 | 0 | 0 |
| chr1:36043093-36070834 | 1 | 0 |
| | chr1:36075009-36096875 | chr1:36096945-36101911 |
| chr1:36068975-36070834 | 0 | 0 |
| chr1:36070883-36074847 | 0 | 0 |
| chr1:36075009-36096875 | 1 | 0 |
| chr1:36096945-36101911 | 0 | 1 |
| chr1:36102033-36106943 | 0 | 0 |
| chr1:36043093-36070834 | 0 | 0 |
| | chr1:36102033-36106943 | chr1:36043093-36070834 |
| chr1:36068975-36070834 | 0 | 1 |
| chr1:36070883-36074847 | 0 | 0 |
| chr1:36075009-36096875 | 0 | 0 |
| chr1:36096945-36101911 | 0 | 0 |
| chr1:36102033-36106943 | 1 | 0 |
| chr1:36043093-36070834 | 0 | 1 |

\$Rest\$RBBP4

| | | |
|------------------------|------------------------|------------------------|
| | chr1:33116923-33117515 | chr1:33117662-33123028 |
| chr1:33116923-33117515 | 1 | 0 |
| chr1:33117662-33123028 | 0 | 1 |
| chr1:33123173-33133826 | 0 | 0 |
| chr1:33133999-33134340 | 0 | 0 |
| chr1:33134455-33134573 | 0 | 0 |
| chr1:33134733-33134832 | 0 | 0 |
| chr1:33134958-33135087 | 0 | 0 |
| chr1:33135164-33138051 | 0 | 0 |
| chr1:33138127-33138243 | 0 | 0 |
| chr1:33138300-33138392 | 0 | 0 |
| chr1:33138502-33145241 | 0 | 0 |
| chr1:33116923-33117518 | 1 | 0 |
| | chr1:33123173-33133826 | chr1:33133999-33134340 |
| chr1:33116923-33117515 | 0 | 0 |
| chr1:33117662-33123028 | 0 | 0 |
| chr1:33123173-33133826 | 1 | 0 |
| chr1:33133999-33134340 | 0 | 1 |
| chr1:33134455-33134573 | 0 | 0 |
| chr1:33134733-33134832 | 0 | 0 |
| chr1:33134958-33135087 | 0 | 0 |
| chr1:33135164-33138051 | 0 | 0 |
| chr1:33138127-33138243 | 0 | 0 |
| chr1:33138300-33138392 | 0 | 0 |
| chr1:33138502-33145241 | 0 | 0 |

| | | |
|------------------------|------------------------|------------------------|
| chr1:33116923-33117518 | 0 | 0 |
| | chr1:33134455-33134573 | chr1:33134733-33134832 |
| chr1:33116923-33117515 | 0 | 0 |
| chr1:33117662-33123028 | 0 | 0 |
| chr1:33123173-33133826 | 0 | 0 |
| chr1:33133999-33134340 | 0 | 0 |
| chr1:33134455-33134573 | 1 | 0 |
| chr1:33134733-33134832 | 0 | 1 |
| chr1:33134958-33135087 | 0 | 0 |
| chr1:33135164-33138051 | 0 | 0 |
| chr1:33138127-33138243 | 0 | 0 |
| chr1:33138300-33138392 | 0 | 0 |
| chr1:33138502-33145241 | 0 | 0 |
| chr1:33116923-33117518 | 0 | 0 |
| | chr1:33134958-33135087 | chr1:33135164-33138051 |
| chr1:33116923-33117515 | 0 | 0 |
| chr1:33117662-33123028 | 0 | 0 |
| chr1:33123173-33133826 | 0 | 0 |
| chr1:33133999-33134340 | 0 | 0 |
| chr1:33134455-33134573 | 0 | 0 |
| chr1:33134733-33134832 | 0 | 0 |
| chr1:33134958-33135087 | 1 | 0 |
| chr1:33135164-33138051 | 0 | 1 |
| chr1:33138127-33138243 | 0 | 0 |
| chr1:33138300-33138392 | 0 | 0 |
| chr1:33138502-33145241 | 0 | 0 |
| chr1:33116923-33117518 | 0 | 0 |
| | chr1:33138127-33138243 | chr1:33138300-33138392 |
| chr1:33116923-33117515 | 0 | 0 |
| chr1:33117662-33123028 | 0 | 0 |
| chr1:33123173-33133826 | 0 | 0 |
| chr1:33133999-33134340 | 0 | 0 |
| chr1:33134455-33134573 | 0 | 0 |
| chr1:33134733-33134832 | 0 | 0 |
| chr1:33134958-33135087 | 0 | 0 |
| chr1:33135164-33138051 | 0 | 0 |
| chr1:33138127-33138243 | 1 | 0 |
| chr1:33138300-33138392 | 0 | 1 |
| chr1:33138502-33145241 | 0 | 0 |
| chr1:33116923-33117518 | 0 | 0 |
| | chr1:33138502-33145241 | chr1:33116923-33117518 |
| chr1:33116923-33117515 | 0 | 1 |
| chr1:33117662-33123028 | 0 | 0 |
| chr1:33123173-33133826 | 0 | 0 |
| chr1:33133999-33134340 | 0 | 0 |
| chr1:33134455-33134573 | 0 | 0 |
| chr1:33134733-33134832 | 0 | 0 |
| chr1:33134958-33135087 | 0 | 0 |
| chr1:33135164-33138051 | 0 | 0 |
| chr1:33138127-33138243 | 0 | 0 |
| chr1:33138300-33138392 | 0 | 0 |

| | | |
|------------------------|---|---|
| chr1:33138502-33145241 | 1 | 0 |
| chr1:33116923-33117518 | 0 | 1 |

\$Rest\$RBBP5

| | | |
|--------------------------|--------------------------|--------------------------|
| | chr1:205057943-205064001 | chr1:205057943-205064115 |
| chr1:205057943-205064001 | 1 | 1 |
| chr1:205057943-205064115 | 1 | 1 |
| chr1:205064192-205065810 | 0 | 0 |
| chr1:205066039-205066454 | 0 | 0 |
| chr1:205066523-205068117 | 0 | 0 |
| chr1:205068234-205068869 | 0 | 0 |
| chr1:205068940-205069039 | 0 | 0 |
| chr1:205069192-205069280 | 0 | 0 |
| chr1:205069399-205070728 | 0 | 0 |
| chr1:205070837-205072985 | 0 | 0 |
| chr1:205073147-205074156 | 0 | 0 |
| chr1:205074296-205083917 | 0 | 0 |
| chr1:205084033-205084986 | 0 | 0 |
| chr1:205084089-205084986 | 0 | 0 |
| chr1:205085011-205090983 | 0 | 0 |
| chr1:205057940-205064001 | 1 | 1 |
| | chr1:205064192-205065810 | chr1:205066039-205066454 |
| chr1:205057943-205064001 | 0 | 0 |
| chr1:205057943-205064115 | 0 | 0 |
| chr1:205064192-205065810 | 1 | 0 |
| chr1:205066039-205066454 | 0 | 1 |
| chr1:205066523-205068117 | 0 | 0 |
| chr1:205068234-205068869 | 0 | 0 |
| chr1:205068940-205069039 | 0 | 0 |
| chr1:205069192-205069280 | 0 | 0 |
| chr1:205069399-205070728 | 0 | 0 |
| chr1:205070837-205072985 | 0 | 0 |
| chr1:205073147-205074156 | 0 | 0 |
| chr1:205074296-205083917 | 0 | 0 |
| chr1:205084033-205084986 | 0 | 0 |
| chr1:205084089-205084986 | 0 | 0 |
| chr1:205085011-205090983 | 0 | 0 |
| chr1:205057940-205064001 | 0 | 0 |
| | chr1:205066523-205068117 | chr1:205068234-205068869 |
| chr1:205057943-205064001 | 0 | 0 |
| chr1:205057943-205064115 | 0 | 0 |
| chr1:205064192-205065810 | 0 | 0 |
| chr1:205066039-205066454 | 0 | 0 |
| chr1:205066523-205068117 | 1 | 0 |
| chr1:205068234-205068869 | 0 | 1 |
| chr1:205068940-205069039 | 0 | 0 |
| chr1:205069192-205069280 | 0 | 0 |
| chr1:205069399-205070728 | 0 | 0 |
| chr1:205070837-205072985 | 0 | 0 |
| chr1:205073147-205074156 | 0 | 0 |
| chr1:205074296-205083917 | 0 | 0 |

| | | |
|--------------------------|---|---|
| chr1:205084033-205084986 | 0 | 0 |
| chr1:205084089-205084986 | 0 | 0 |
| chr1:205085011-205090983 | 0 | 0 |
| chr1:205057940-205064001 | 0 | 0 |
| chr1:205057943-205064001 | 0 | 0 |
| chr1:205057943-205064115 | 0 | 0 |
| chr1:205064192-205065810 | 0 | 0 |
| chr1:205066039-205066454 | 0 | 0 |
| chr1:205066523-205068117 | 0 | 0 |
| chr1:205068234-205068869 | 0 | 0 |
| chr1:205068940-205069039 | 1 | 0 |
| chr1:205069192-205069280 | 0 | 1 |
| chr1:205069399-205070728 | 0 | 0 |
| chr1:205070837-205072985 | 0 | 0 |
| chr1:205073147-205074156 | 0 | 0 |
| chr1:205074296-205083917 | 0 | 0 |
| chr1:205084033-205084986 | 0 | 0 |
| chr1:205084089-205084986 | 0 | 0 |
| chr1:205085011-205090983 | 0 | 0 |
| chr1:205057940-205064001 | 0 | 0 |
| chr1:205057943-205064001 | 0 | 0 |
| chr1:205057943-205064115 | 0 | 0 |
| chr1:205064192-205065810 | 0 | 0 |
| chr1:205066039-205066454 | 0 | 0 |
| chr1:205066523-205068117 | 0 | 0 |
| chr1:205068234-205068869 | 0 | 0 |
| chr1:205068940-205069039 | 0 | 0 |
| chr1:205069192-205069280 | 0 | 0 |
| chr1:205069399-205070728 | 1 | 0 |
| chr1:205070837-205072985 | 0 | 1 |
| chr1:205073147-205074156 | 0 | 0 |
| chr1:205074296-205083917 | 0 | 0 |
| chr1:205084033-205084986 | 0 | 0 |
| chr1:205084089-205084986 | 0 | 0 |
| chr1:205085011-205090983 | 0 | 0 |
| chr1:205057940-205064001 | 0 | 0 |
| chr1:205057943-205064001 | 0 | 0 |
| chr1:205057943-205064115 | 0 | 0 |
| chr1:205064192-205065810 | 0 | 0 |
| chr1:205066039-205066454 | 0 | 0 |
| chr1:205066523-205068117 | 0 | 0 |
| chr1:205068234-205068869 | 0 | 0 |
| chr1:205068940-205069039 | 0 | 0 |
| chr1:205069192-205069280 | 0 | 0 |
| chr1:205069399-205070728 | 0 | 0 |
| chr1:205070837-205072985 | 0 | 0 |
| chr1:205073147-205074156 | 1 | 0 |
| chr1:205074296-205083917 | 0 | 1 |

| | | |
|--------------------------|--------------------------|----------------------|
| chr1:205084033-205084986 | 0 | 0 |
| chr1:205084089-205084986 | 0 | 0 |
| chr1:205085011-205090983 | 0 | 0 |
| chr1:205057940-205064001 | 0 | 0 |
| chr1:205084033-205084986 | chr1:205084089-205084986 | |
| chr1:205057943-205064001 | 0 | 0 |
| chr1:205057943-205064115 | 0 | 0 |
| chr1:205064192-205065810 | 0 | 0 |
| chr1:205066039-205066454 | 0 | 0 |
| chr1:205066523-205068117 | 0 | 0 |
| chr1:205068234-205068869 | 0 | 0 |
| chr1:205068940-205069039 | 0 | 0 |
| chr1:205069192-205069280 | 0 | 0 |
| chr1:205069399-205070728 | 0 | 0 |
| chr1:205070837-205072985 | 0 | 0 |
| chr1:205073147-205074156 | 0 | 0 |
| chr1:205074296-205083917 | 0 | 0 |
| chr1:205084033-205084986 | 1 | 1 |
| chr1:205084089-205084986 | 1 | 1 |
| chr1:205085011-205090983 | 0 | 0 |
| chr1:205057940-205064001 | 0 | 0 |
| chr1:205085011-205090983 | chr1:205057940-205064001 | |
| chr1:205057943-205064001 | 0 | 1 |
| chr1:205057943-205064115 | 0 | 1 |
| chr1:205064192-205065810 | 0 | 0 |
| chr1:205066039-205066454 | 0 | 0 |
| chr1:205066523-205068117 | 0 | 0 |
| chr1:205068234-205068869 | 0 | 0 |
| chr1:205068940-205069039 | 0 | 0 |
| chr1:205069192-205069280 | 0 | 0 |
| chr1:205069399-205070728 | 0 | 0 |
| chr1:205070837-205072985 | 0 | 0 |
| chr1:205073147-205074156 | 0 | 0 |
| chr1:205074296-205083917 | 0 | 0 |
| chr1:205084033-205084986 | 0 | 0 |
| chr1:205084089-205084986 | 0 | 0 |
| chr1:205085011-205090983 | 1 | 0 |
| chr1:205057940-205064001 | 0 | 1 |
| \$Rest\$RERE | | |
| chr1:8415180-8415479 | chr1:8415659-8416160 | chr1:8416306-8418256 |
| chr1:8415180-8415479 | 1 | 0 |
| chr1:8415659-8416160 | 0 | 1 |
| chr1:8416306-8418256 | 0 | 0 |
| chr1:8418976-8419824 | 0 | 0 |
| chr1:8420046-8420172 | 0 | 0 |
| chr1:8421550-8421823 | 0 | 0 |
| chr1:8421936-8422743 | 0 | 0 |
| chr1:8422904-8424116 | 0 | 0 |
| chr1:8424315-8424806 | 0 | 0 |
| chr1:8424898-8425872 | 0 | 0 |

| | | | |
|----------------------|----------------------|----------------------|---|
| chr1:8426034-8482787 | 0 | 0 | 0 |
| chr1:8482867-8525985 | 0 | 0 | 0 |
| chr1:8526083-8555123 | 0 | 0 | 0 |
| chr1:8555222-8557465 | 0 | 0 | 0 |
| chr1:8557589-8568686 | 0 | 0 | 0 |
| chr1:8568734-8601273 | 0 | 0 | 0 |
| chr1:8601377-8616534 | 0 | 0 | 0 |
| chr1:8616630-8617477 | 0 | 0 | 0 |
| chr1:8617582-8674620 | 0 | 0 | 0 |
| chr1:8674745-8684369 | 0 | 0 | 0 |
| chr1:8684439-8716032 | 0 | 0 | 0 |
| chr1:8716500-8813490 | 0 | 0 | 0 |
| chr1:8716500-8877219 | 0 | 0 | 0 |
| chr1:8482867-8483621 | 0 | 0 | 0 |
| chr1:8852647-8877219 | 0 | 0 | 0 |
| chr1:8716500-8852463 | 0 | 0 | 0 |
| chr1:8418976-8419824 | chr1:8420046-8420172 | chr1:8421550-8421823 | |
| chr1:8415180-8415479 | 0 | 0 | 0 |
| chr1:8415659-8416160 | 0 | 0 | 0 |
| chr1:8416306-8418256 | 0 | 0 | 0 |
| chr1:8418976-8419824 | 1 | 0 | 0 |
| chr1:8420046-8420172 | 0 | 1 | 0 |
| chr1:8421550-8421823 | 0 | 0 | 1 |
| chr1:8421936-8422743 | 0 | 0 | 0 |
| chr1:8422904-8424116 | 0 | 0 | 0 |
| chr1:8424315-8424806 | 0 | 0 | 0 |
| chr1:8424898-8425872 | 0 | 0 | 0 |
| chr1:8426034-8482787 | 0 | 0 | 0 |
| chr1:8482867-8525985 | 0 | 0 | 0 |
| chr1:8526083-8555123 | 0 | 0 | 0 |
| chr1:8555222-8557465 | 0 | 0 | 0 |
| chr1:8557589-8568686 | 0 | 0 | 0 |
| chr1:8568734-8601273 | 0 | 0 | 0 |
| chr1:8601377-8616534 | 0 | 0 | 0 |
| chr1:8616630-8617477 | 0 | 0 | 0 |
| chr1:8617582-8674620 | 0 | 0 | 0 |
| chr1:8674745-8684369 | 0 | 0 | 0 |
| chr1:8684439-8716032 | 0 | 0 | 0 |
| chr1:8716500-8813490 | 0 | 0 | 0 |
| chr1:8716500-8877219 | 0 | 0 | 0 |
| chr1:8482867-8483621 | 0 | 0 | 0 |
| chr1:8852647-8877219 | 0 | 0 | 0 |
| chr1:8716500-8852463 | 0 | 0 | 0 |
| chr1:8421936-8422743 | chr1:8422904-8424116 | chr1:8424315-8424806 | |
| chr1:8415180-8415479 | 0 | 0 | 0 |
| chr1:8415659-8416160 | 0 | 0 | 0 |
| chr1:8416306-8418256 | 0 | 0 | 0 |
| chr1:8418976-8419824 | 0 | 0 | 0 |
| chr1:8420046-8420172 | 0 | 0 | 0 |
| chr1:8421550-8421823 | 0 | 0 | 0 |
| chr1:8421936-8422743 | 1 | 0 | 0 |

| | | | |
|----------------------|----------------------|----------------------|---|
| chr1:8422904-8424116 | 0 | 1 | 0 |
| chr1:8424315-8424806 | 0 | 0 | 1 |
| chr1:8424898-8425872 | 0 | 0 | 0 |
| chr1:8426034-8482787 | 0 | 0 | 0 |
| chr1:8482867-8525985 | 0 | 0 | 0 |
| chr1:8526083-8555123 | 0 | 0 | 0 |
| chr1:8555222-8557465 | 0 | 0 | 0 |
| chr1:8557589-8568686 | 0 | 0 | 0 |
| chr1:8568734-8601273 | 0 | 0 | 0 |
| chr1:8601377-8616534 | 0 | 0 | 0 |
| chr1:8616630-8617477 | 0 | 0 | 0 |
| chr1:8617582-8674620 | 0 | 0 | 0 |
| chr1:8674745-8684369 | 0 | 0 | 0 |
| chr1:8684439-8716032 | 0 | 0 | 0 |
| chr1:8716500-8813490 | 0 | 0 | 0 |
| chr1:8716500-8877219 | 0 | 0 | 0 |
| chr1:8482867-8483621 | 0 | 0 | 0 |
| chr1:8852647-8877219 | 0 | 0 | 0 |
| chr1:8716500-8852463 | 0 | 0 | 0 |
| chr1:8424898-8425872 | chr1:8426034-8482787 | chr1:8482867-8525985 | |
| chr1:8415180-8415479 | 0 | 0 | 0 |
| chr1:8415659-8416160 | 0 | 0 | 0 |
| chr1:8416306-8418256 | 0 | 0 | 0 |
| chr1:8418976-8419824 | 0 | 0 | 0 |
| chr1:8420046-8420172 | 0 | 0 | 0 |
| chr1:8421550-8421823 | 0 | 0 | 0 |
| chr1:8421936-8422743 | 0 | 0 | 0 |
| chr1:8422904-8424116 | 0 | 0 | 0 |
| chr1:8424315-8424806 | 0 | 0 | 0 |
| chr1:8424898-8425872 | 1 | 0 | 0 |
| chr1:8426034-8482787 | 0 | 1 | 0 |
| chr1:8482867-8525985 | 0 | 0 | 1 |
| chr1:8526083-8555123 | 0 | 0 | 0 |
| chr1:8555222-8557465 | 0 | 0 | 0 |
| chr1:8557589-8568686 | 0 | 0 | 0 |
| chr1:8568734-8601273 | 0 | 0 | 0 |
| chr1:8601377-8616534 | 0 | 0 | 0 |
| chr1:8616630-8617477 | 0 | 0 | 0 |
| chr1:8617582-8674620 | 0 | 0 | 0 |
| chr1:8674745-8684369 | 0 | 0 | 0 |
| chr1:8684439-8716032 | 0 | 0 | 0 |
| chr1:8716500-8813490 | 0 | 0 | 0 |
| chr1:8716500-8877219 | 0 | 0 | 0 |
| chr1:8482867-8483621 | 0 | 0 | 1 |
| chr1:8852647-8877219 | 0 | 0 | 0 |
| chr1:8716500-8852463 | 0 | 0 | 0 |
| chr1:8526083-8555123 | chr1:8555222-8557465 | chr1:8557589-8568686 | |
| chr1:8415180-8415479 | 0 | 0 | 0 |
| chr1:8415659-8416160 | 0 | 0 | 0 |
| chr1:8416306-8418256 | 0 | 0 | 0 |
| chr1:8418976-8419824 | 0 | 0 | 0 |

| | | | |
|----------------------|----------------------|----------------------|---|
| chr1:8420046-8420172 | 0 | 0 | 0 |
| chr1:8421550-8421823 | 0 | 0 | 0 |
| chr1:8421936-8422743 | 0 | 0 | 0 |
| chr1:8422904-8424116 | 0 | 0 | 0 |
| chr1:8424315-8424806 | 0 | 0 | 0 |
| chr1:8424898-8425872 | 0 | 0 | 0 |
| chr1:8426034-8482787 | 0 | 0 | 0 |
| chr1:8482867-8525985 | 0 | 0 | 0 |
| chr1:8526083-8555123 | 1 | 0 | 0 |
| chr1:8555222-8557465 | 0 | 1 | 0 |
| chr1:8557589-8568686 | 0 | 0 | 1 |
| chr1:8568734-8601273 | 0 | 0 | 0 |
| chr1:8601377-8616534 | 0 | 0 | 0 |
| chr1:8616630-8617477 | 0 | 0 | 0 |
| chr1:8617582-8674620 | 0 | 0 | 0 |
| chr1:8674745-8684369 | 0 | 0 | 0 |
| chr1:8684439-8716032 | 0 | 0 | 0 |
| chr1:8716500-8813490 | 0 | 0 | 0 |
| chr1:8716500-8877219 | 0 | 0 | 0 |
| chr1:8482867-8483621 | 0 | 0 | 0 |
| chr1:8852647-8877219 | 0 | 0 | 0 |
| chr1:8716500-8852463 | 0 | 0 | 0 |
| chr1:8568734-8601273 | chr1:8601377-8616534 | chr1:8616630-8617477 | |
| chr1:8415180-8415479 | 0 | 0 | 0 |
| chr1:8415659-8416160 | 0 | 0 | 0 |
| chr1:8416306-8418256 | 0 | 0 | 0 |
| chr1:8418976-8419824 | 0 | 0 | 0 |
| chr1:8420046-8420172 | 0 | 0 | 0 |
| chr1:8421550-8421823 | 0 | 0 | 0 |
| chr1:8421936-8422743 | 0 | 0 | 0 |
| chr1:8422904-8424116 | 0 | 0 | 0 |
| chr1:8424315-8424806 | 0 | 0 | 0 |
| chr1:8424898-8425872 | 0 | 0 | 0 |
| chr1:8426034-8482787 | 0 | 0 | 0 |
| chr1:8482867-8525985 | 0 | 0 | 0 |
| chr1:8526083-8555123 | 0 | 0 | 0 |
| chr1:8555222-8557465 | 0 | 0 | 0 |
| chr1:8557589-8568686 | 0 | 0 | 0 |
| chr1:8568734-8601273 | 1 | 0 | 0 |
| chr1:8601377-8616534 | 0 | 1 | 0 |
| chr1:8616630-8617477 | 0 | 0 | 1 |
| chr1:8617582-8674620 | 0 | 0 | 0 |
| chr1:8674745-8684369 | 0 | 0 | 0 |
| chr1:8684439-8716032 | 0 | 0 | 0 |
| chr1:8716500-8813490 | 0 | 0 | 0 |
| chr1:8716500-8877219 | 0 | 0 | 0 |
| chr1:8482867-8483621 | 0 | 0 | 0 |
| chr1:8852647-8877219 | 0 | 0 | 0 |
| chr1:8716500-8852463 | 0 | 0 | 0 |
| chr1:8617582-8674620 | chr1:8674745-8684369 | chr1:8684439-8716032 | |
| chr1:8415180-8415479 | 0 | 0 | 0 |

| | | | |
|--|---|---|---|
| chr1:8415659-8416160 | 0 | 0 | 0 |
| chr1:8416306-8418256 | 0 | 0 | 0 |
| chr1:8418976-8419824 | 0 | 0 | 0 |
| chr1:8420046-8420172 | 0 | 0 | 0 |
| chr1:8421550-8421823 | 0 | 0 | 0 |
| chr1:8421936-8422743 | 0 | 0 | 0 |
| chr1:8422904-8424116 | 0 | 0 | 0 |
| chr1:8424315-8424806 | 0 | 0 | 0 |
| chr1:8424898-8425872 | 0 | 0 | 0 |
| chr1:8426034-8482787 | 0 | 0 | 0 |
| chr1:8482867-8525985 | 0 | 0 | 0 |
| chr1:8526083-8555123 | 0 | 0 | 0 |
| chr1:8555222-8557465 | 0 | 0 | 0 |
| chr1:8557589-8568686 | 0 | 0 | 0 |
| chr1:8568734-8601273 | 0 | 0 | 0 |
| chr1:8601377-8616534 | 0 | 0 | 0 |
| chr1:8616630-8617477 | 0 | 0 | 0 |
| chr1:8617582-8674620 | 1 | 0 | 0 |
| chr1:8674745-8684369 | 0 | 1 | 0 |
| chr1:8684439-8716032 | 0 | 0 | 1 |
| chr1:8716500-8813490 | 0 | 0 | 0 |
| chr1:8716500-8877219 | 0 | 0 | 0 |
| chr1:8482867-8483621 | 0 | 0 | 0 |
| chr1:8852647-8877219 | 0 | 0 | 0 |
| chr1:8716500-8852463 | 0 | 0 | 0 |
| chr1:8716500-8813490 chr1:8716500-8877219 chr1:8482867-8483621 | | | |
| chr1:8415180-8415479 | 0 | 0 | 0 |
| chr1:8415659-8416160 | 0 | 0 | 0 |
| chr1:8416306-8418256 | 0 | 0 | 0 |
| chr1:8418976-8419824 | 0 | 0 | 0 |
| chr1:8420046-8420172 | 0 | 0 | 0 |
| chr1:8421550-8421823 | 0 | 0 | 0 |
| chr1:8421936-8422743 | 0 | 0 | 0 |
| chr1:8422904-8424116 | 0 | 0 | 0 |
| chr1:8424315-8424806 | 0 | 0 | 0 |
| chr1:8424898-8425872 | 0 | 0 | 0 |
| chr1:8426034-8482787 | 0 | 0 | 0 |
| chr1:8482867-8525985 | 0 | 0 | 1 |
| chr1:8526083-8555123 | 0 | 0 | 0 |
| chr1:8555222-8557465 | 0 | 0 | 0 |
| chr1:8557589-8568686 | 0 | 0 | 0 |
| chr1:8568734-8601273 | 0 | 0 | 0 |
| chr1:8601377-8616534 | 0 | 0 | 0 |
| chr1:8616630-8617477 | 0 | 0 | 0 |
| chr1:8617582-8674620 | 0 | 0 | 0 |
| chr1:8674745-8684369 | 0 | 0 | 0 |
| chr1:8684439-8716032 | 0 | 0 | 0 |
| chr1:8716500-8813490 | 1 | 1 | 0 |
| chr1:8716500-8877219 | 1 | 1 | 0 |
| chr1:8482867-8483621 | 0 | 0 | 1 |
| chr1:8852647-8877219 | 0 | 1 | 0 |

| | | | |
|--------------------------|--------------------------|---|---|
| chr1:8716500-8852463 | 1 | 1 | 0 |
| chr1:8852647-8877219 | chr1:8716500-8852463 | | |
| chr1:8415180-8415479 | 0 | 0 | |
| chr1:8415659-8416160 | 0 | 0 | |
| chr1:8416306-8418256 | 0 | 0 | |
| chr1:8418976-8419824 | 0 | 0 | |
| chr1:8420046-8420172 | 0 | 0 | |
| chr1:8421550-8421823 | 0 | 0 | |
| chr1:8421936-8422743 | 0 | 0 | |
| chr1:8422904-8424116 | 0 | 0 | |
| chr1:8424315-8424806 | 0 | 0 | |
| chr1:8424898-8425872 | 0 | 0 | |
| chr1:8426034-8482787 | 0 | 0 | |
| chr1:8482867-8525985 | 0 | 0 | |
| chr1:8526083-8555123 | 0 | 0 | |
| chr1:8555222-8557465 | 0 | 0 | |
| chr1:8557589-8568686 | 0 | 0 | |
| chr1:8568734-8601273 | 0 | 0 | |
| chr1:8601377-8616534 | 0 | 0 | |
| chr1:8616630-8617477 | 0 | 0 | |
| chr1:8617582-8674620 | 0 | 0 | |
| chr1:8674745-8684369 | 0 | 0 | |
| chr1:8684439-8716032 | 0 | 0 | |
| chr1:8716500-8813490 | 0 | 1 | |
| chr1:8716500-8877219 | 1 | 1 | |
| chr1:8482867-8483621 | 0 | 0 | |
| chr1:8852647-8877219 | 1 | 0 | |
| chr1:8716500-8852463 | 0 | 1 | |
| | | | |
| \$Rest\$`RERE-AS1` | | | |
| chr1:8482867-8525985 | 1 | | |
| | | | |
| \$Rest\$SLAMF7 | | | |
| chr1:160709146-160717984 | chr1:160709146-160719611 | | |
| chr1:160709146-160717984 | 1 | 1 | |
| chr1:160709146-160719611 | 1 | 1 | |
| chr1:160718304-160719611 | 0 | 1 | |
| chr1:160719883-160720094 | 0 | 0 | |
| chr1:160719922-160720094 | 0 | 0 | |
| chr1:160720213-160721135 | 0 | 0 | |
| chr1:160720213-160721976 | 0 | 0 | |
| chr1:160721238-160721976 | 0 | 0 | |
| chr1:160722038-160722896 | 0 | 0 | |
| chr1:160718304-160719611 | chr1:160719883-160720094 | | |
| chr1:160709146-160717984 | 0 | 0 | |
| chr1:160709146-160719611 | 1 | 0 | |
| chr1:160718304-160719611 | 1 | 0 | |
| chr1:160719883-160720094 | 0 | 1 | |
| chr1:160719922-160720094 | 0 | 1 | |
| chr1:160720213-160721135 | 0 | 0 | |

| | | |
|--------------------------|--------------------------|---|
| chr1:160720213-160721976 | 0 | 0 |
| chr1:160721238-160721976 | 0 | 0 |
| chr1:160722038-160722896 | 0 | 0 |
| chr1:160719922-160720094 | chr1:160720213-160721135 | |
| chr1:160709146-160717984 | 0 | 0 |
| chr1:160709146-160719611 | 0 | 0 |
| chr1:160718304-160719611 | 0 | 0 |
| chr1:160719883-160720094 | 1 | 0 |
| chr1:160719922-160720094 | 1 | 0 |
| chr1:160720213-160721135 | 0 | 1 |
| chr1:160720213-160721976 | 0 | 1 |
| chr1:160721238-160721976 | 0 | 0 |
| chr1:160722038-160722896 | 0 | 0 |
| chr1:160720213-160721976 | chr1:160721238-160721976 | |
| chr1:160709146-160717984 | 0 | 0 |
| chr1:160709146-160719611 | 0 | 0 |
| chr1:160718304-160719611 | 0 | 0 |
| chr1:160719883-160720094 | 0 | 0 |
| chr1:160719922-160720094 | 0 | 0 |
| chr1:160720213-160721135 | 1 | 0 |
| chr1:160720213-160721976 | 1 | 1 |
| chr1:160721238-160721976 | 1 | 1 |
| chr1:160722038-160722896 | 0 | 0 |
| chr1:160722038-160722896 | | |
| chr1:160709146-160717984 | 0 | |
| chr1:160709146-160719611 | 0 | |
| chr1:160718304-160719611 | 0 | |
| chr1:160719883-160720094 | 0 | |
| chr1:160719922-160720094 | 0 | |
| chr1:160720213-160721135 | 0 | |
| chr1:160720213-160721976 | 0 | |
| chr1:160721238-160721976 | 0 | |
| chr1:160722038-160722896 | 1 | |
| \$Rest\$SLC41A1 | | |
| chr1:205760846-205763998 | chr1:205764146-205764472 | |
| chr1:205760846-205763998 | 1 | 0 |
| chr1:205764146-205764472 | 0 | 1 |
| chr1:205764606-205766052 | 0 | 0 |
| chr1:205766131-205767032 | 0 | 0 |
| chr1:205767179-205767797 | 0 | 0 |
| chr1:205767943-205768085 | 0 | 0 |
| chr1:205768229-205768887 | 0 | 0 |
| chr1:205768958-205770081 | 0 | 0 |
| chr1:205770188-205779198 | 0 | 0 |
| chr1:205780215-205781936 | 0 | 0 |
| chr1:205764606-205766052 | chr1:205766131-205767032 | |
| chr1:205760846-205763998 | 0 | 0 |
| chr1:205764146-205764472 | 0 | 0 |
| chr1:205764606-205766052 | 1 | 0 |
| chr1:205766131-205767032 | 0 | 1 |

| | | |
|---|---|---|
| chr1:205767179-205767797 | 0 | 0 |
| chr1:205767943-205768085 | 0 | 0 |
| chr1:205768229-205768887 | 0 | 0 |
| chr1:205768958-205770081 | 0 | 0 |
| chr1:205770188-205779198 | 0 | 0 |
| chr1:205780215-205781936 | 0 | 0 |
| chr1:205767179-205767797 chr1:205767943-205768085 | | |
| chr1:205760846-205763998 | 0 | 0 |
| chr1:205764146-205764472 | 0 | 0 |
| chr1:205764606-205766052 | 0 | 0 |
| chr1:205766131-205767032 | 0 | 0 |
| chr1:205767179-205767797 | 1 | 0 |
| chr1:205767943-205768085 | 0 | 1 |
| chr1:205768229-205768887 | 0 | 0 |
| chr1:205768958-205770081 | 0 | 0 |
| chr1:205770188-205779198 | 0 | 0 |
| chr1:205780215-205781936 | 0 | 0 |
| chr1:205768229-205768887 chr1:205768958-205770081 | | |
| chr1:205760846-205763998 | 0 | 0 |
| chr1:205764146-205764472 | 0 | 0 |
| chr1:205764606-205766052 | 0 | 0 |
| chr1:205766131-205767032 | 0 | 0 |
| chr1:205767179-205767797 | 0 | 0 |
| chr1:205767943-205768085 | 0 | 0 |
| chr1:205768229-205768887 | 1 | 0 |
| chr1:205768958-205770081 | 0 | 1 |
| chr1:205770188-205779198 | 0 | 0 |
| chr1:205780215-205781936 | 0 | 0 |
| chr1:205770188-205779198 chr1:205780215-205781936 | | |
| chr1:205760846-205763998 | 0 | 0 |
| chr1:205764146-205764472 | 0 | 0 |
| chr1:205764606-205766052 | 0 | 0 |
| chr1:205766131-205767032 | 0 | 0 |
| chr1:205767179-205767797 | 0 | 0 |
| chr1:205767943-205768085 | 0 | 0 |
| chr1:205768229-205768887 | 0 | 0 |
| chr1:205768958-205770081 | 0 | 0 |
| chr1:205770188-205779198 | 1 | 0 |
| chr1:205780215-205781936 | 0 | 1 |
| \$Rest\$TFAP2E | | |
| chr1:36040299-36042923 chr1:36043093-36070834 | | |
| chr1:36040299-36042923 | 1 | 0 |
| chr1:36043093-36070834 | 0 | 1 |
| \$Rest\$`TFAP2E-AS1` | | |
| chr1:36040299-36042923 chr1:36043093-36070834 | | |
| chr1:36040299-36042923 | 1 | 0 |
| chr1:36043093-36070834 | 0 | 1 |
| \$Rest\$TMEM51 | | |

| | | |
|--------------------------|--------------------------|--------------------------|
| | chr1:15479280-15541391 | chr1:15480450-15541391 |
| chr1:15479280-15541391 | 1 | 1 |
| chr1:15480450-15541391 | 1 | 1 |
| chr1:15541927-15545822 | 0 | 0 |
| chr1:15480450-15536986 | 1 | 1 |
| chr1:15537058-15541391 | 1 | 1 |
| | chr1:15541927-15545822 | chr1:15480450-15536986 |
| chr1:15479280-15541391 | 0 | 1 |
| chr1:15480450-15541391 | 0 | 1 |
| chr1:15541927-15545822 | 1 | 0 |
| chr1:15480450-15536986 | 0 | 1 |
| chr1:15537058-15541391 | 0 | 0 |
| | chr1:15537058-15541391 | |
| chr1:15479280-15541391 | 1 | |
| chr1:15480450-15541391 | 1 | |
| chr1:15541927-15545822 | 0 | |
| chr1:15480450-15536986 | 0 | |
| chr1:15537058-15541391 | 1 | |
| \$Rest\$`TMEM51-AS1` | | |
| | chr1:15479280-15541391 | |
| chr1:15479280-15541391 | 1 | |
| \$Rest\$`TMEM51-AS2` | | |
| | chr1:15479280-15541391 | chr1:15480450-15541391 |
| chr1:15479280-15541391 | 1 | 1 |
| chr1:15480450-15541391 | 1 | 1 |
| chr1:15480450-15536986 | 1 | 1 |
| | chr1:15480450-15536986 | |
| chr1:15479280-15541391 | 1 | |
| chr1:15480450-15541391 | 1 | |
| chr1:15480450-15536986 | 1 | |
| \$Rest\$TMEM63A | | |
| | chr1:226034633-226034735 | chr1:226034914-226036193 |
| chr1:226034633-226034735 | 1 | 0 |
| chr1:226034914-226036193 | 0 | 1 |
| chr1:226036255-226036598 | 0 | 0 |
| chr1:226036713-226037613 | 0 | 0 |
| chr1:226037780-226040365 | 0 | 0 |
| chr1:226040470-226041330 | 0 | 0 |
| chr1:226041492-226043579 | 0 | 0 |
| chr1:226043641-226044353 | 0 | 0 |
| chr1:226044439-226044611 | 0 | 0 |
| chr1:226044717-226046896 | 0 | 0 |
| chr1:226047049-226048560 | 0 | 0 |
| chr1:226048697-226049918 | 0 | 0 |
| chr1:226050051-226050155 | 0 | 0 |
| chr1:226050278-226050471 | 0 | 0 |
| chr1:226050551-226053597 | 0 | 0 |
| chr1:226053667-226054274 | 0 | 0 |

| | | |
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| chr1:226054382-226054812 | 0 | 0 |
| chr1:226054863-226055588 | 0 | 0 |
| chr1:226055730-226058776 | 0 | 0 |
| chr1:226058813-226059687 | 0 | 0 |
| chr1:226059753-226061988 | 0 | 0 |
| chr1:226062067-226065095 | 0 | 0 |
| chr1:226065294-226066920 | 0 | 0 |
| chr1:226067110-226070004 | 0 | 0 |
| chr1:226036255-226036598 | chr1:226036713-226037613 | |
| chr1:226034633-226034735 | 0 | 0 |
| chr1:226034914-226036193 | 0 | 0 |
| chr1:226036255-226036598 | 1 | 0 |
| chr1:226036713-226037613 | 0 | 1 |
| chr1:226037780-226040365 | 0 | 0 |
| chr1:226040470-226041330 | 0 | 0 |
| chr1:226041492-226043579 | 0 | 0 |
| chr1:226043641-226044353 | 0 | 0 |
| chr1:226044439-226044611 | 0 | 0 |
| chr1:226044717-226046896 | 0 | 0 |
| chr1:226047049-226048560 | 0 | 0 |
| chr1:226048697-226049918 | 0 | 0 |
| chr1:226050051-226050155 | 0 | 0 |
| chr1:226050278-226050471 | 0 | 0 |
| chr1:226050551-226053597 | 0 | 0 |
| chr1:226053667-226054274 | 0 | 0 |
| chr1:226054382-226054812 | 0 | 0 |
| chr1:226054863-226055588 | 0 | 0 |
| chr1:226055730-226058776 | 0 | 0 |
| chr1:226058813-226059687 | 0 | 0 |
| chr1:226059753-226061988 | 0 | 0 |
| chr1:226062067-226065095 | 0 | 0 |
| chr1:226065294-226066920 | 0 | 0 |
| chr1:226067110-226070004 | 0 | 0 |
| chr1:226037780-226040365 | chr1:226040470-226041330 | |
| chr1:226034633-226034735 | 0 | 0 |
| chr1:226034914-226036193 | 0 | 0 |
| chr1:226036255-226036598 | 0 | 0 |
| chr1:226036713-226037613 | 0 | 0 |
| chr1:226037780-226040365 | 1 | 0 |
| chr1:226040470-226041330 | 0 | 1 |
| chr1:226041492-226043579 | 0 | 0 |
| chr1:226043641-226044353 | 0 | 0 |
| chr1:226044439-226044611 | 0 | 0 |
| chr1:226044717-226046896 | 0 | 0 |
| chr1:226047049-226048560 | 0 | 0 |
| chr1:226048697-226049918 | 0 | 0 |
| chr1:226050051-226050155 | 0 | 0 |
| chr1:226050278-226050471 | 0 | 0 |
| chr1:226050551-226053597 | 0 | 0 |
| chr1:226053667-226054274 | 0 | 0 |
| chr1:226054382-226054812 | 0 | 0 |

| | | |
|--------------------------|--------------------------|---|
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| chr1:226055730-226058776 | 0 | 0 |
| chr1:226058813-226059687 | 0 | 0 |
| chr1:226059753-226061988 | 0 | 0 |
| chr1:226062067-226065095 | 0 | 0 |
| chr1:226065294-226066920 | 0 | 0 |
| chr1:226067110-226070004 | 0 | 0 |
| chr1:226041492-226043579 | chr1:226043641-226044353 | |
| chr1:226034633-226034735 | 0 | 0 |
| chr1:226034914-226036193 | 0 | 0 |
| chr1:226036255-226036598 | 0 | 0 |
| chr1:226036713-226037613 | 0 | 0 |
| chr1:226037780-226040365 | 0 | 0 |
| chr1:226040470-226041330 | 0 | 0 |
| chr1:226041492-226043579 | 1 | 0 |
| chr1:226043641-226044353 | 0 | 1 |
| chr1:226044439-226044611 | 0 | 0 |
| chr1:226044717-226046896 | 0 | 0 |
| chr1:226047049-226048560 | 0 | 0 |
| chr1:226048697-226049918 | 0 | 0 |
| chr1:226050051-226050155 | 0 | 0 |
| chr1:226050278-226050471 | 0 | 0 |
| chr1:226050551-226053597 | 0 | 0 |
| chr1:226053667-226054274 | 0 | 0 |
| chr1:226054382-226054812 | 0 | 0 |
| chr1:226054863-226055588 | 0 | 0 |
| chr1:226055730-226058776 | 0 | 0 |
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| chr1:226059753-226061988 | 0 | 0 |
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| chr1:226065294-226066920 | 0 | 0 |
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| chr1:226044439-226044611 | chr1:226044717-226046896 | |
| chr1:226034633-226034735 | 0 | 0 |
| chr1:226034914-226036193 | 0 | 0 |
| chr1:226036255-226036598 | 0 | 0 |
| chr1:226036713-226037613 | 0 | 0 |
| chr1:226037780-226040365 | 0 | 0 |
| chr1:226040470-226041330 | 0 | 0 |
| chr1:226041492-226043579 | 0 | 0 |
| chr1:226043641-226044353 | 0 | 0 |
| chr1:226044439-226044611 | 1 | 0 |
| chr1:226044717-226046896 | 0 | 1 |
| chr1:226047049-226048560 | 0 | 0 |
| chr1:226048697-226049918 | 0 | 0 |
| chr1:226050051-226050155 | 0 | 0 |
| chr1:226050278-226050471 | 0 | 0 |
| chr1:226050551-226053597 | 0 | 0 |
| chr1:226053667-226054274 | 0 | 0 |
| chr1:226054382-226054812 | 0 | 0 |
| chr1:226054863-226055588 | 0 | 0 |

| | | |
|--------------------------|--------------------------|---|
| chr1:226055730-226058776 | 0 | 0 |
| chr1:226058813-226059687 | 0 | 0 |
| chr1:226059753-226061988 | 0 | 0 |
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| chr1:226065294-226066920 | 0 | 0 |
| chr1:226067110-226070004 | 0 | 0 |
| chr1:226047049-226048560 | chr1:226048697-226049918 | |
| chr1:226034633-226034735 | 0 | 0 |
| chr1:226034914-226036193 | 0 | 0 |
| chr1:226036255-226036598 | 0 | 0 |
| chr1:226036713-226037613 | 0 | 0 |
| chr1:226037780-226040365 | 0 | 0 |
| chr1:226040470-226041330 | 0 | 0 |
| chr1:226041492-226043579 | 0 | 0 |
| chr1:226043641-226044353 | 0 | 0 |
| chr1:226044439-226044611 | 0 | 0 |
| chr1:226044717-226046896 | 0 | 0 |
| chr1:226047049-226048560 | 1 | 0 |
| chr1:226048697-226049918 | 0 | 1 |
| chr1:226050051-226050155 | 0 | 0 |
| chr1:226050278-226050471 | 0 | 0 |
| chr1:226050551-226053597 | 0 | 0 |
| chr1:226053667-226054274 | 0 | 0 |
| chr1:226054382-226054812 | 0 | 0 |
| chr1:226054863-226055588 | 0 | 0 |
| chr1:226055730-226058776 | 0 | 0 |
| chr1:226058813-226059687 | 0 | 0 |
| chr1:226059753-226061988 | 0 | 0 |
| chr1:226062067-226065095 | 0 | 0 |
| chr1:226065294-226066920 | 0 | 0 |
| chr1:226067110-226070004 | 0 | 0 |
| chr1:226050051-226050155 | chr1:226050278-226050471 | |
| chr1:226034633-226034735 | 0 | 0 |
| chr1:226034914-226036193 | 0 | 0 |
| chr1:226036255-226036598 | 0 | 0 |
| chr1:226036713-226037613 | 0 | 0 |
| chr1:226037780-226040365 | 0 | 0 |
| chr1:226040470-226041330 | 0 | 0 |
| chr1:226041492-226043579 | 0 | 0 |
| chr1:226043641-226044353 | 0 | 0 |
| chr1:226044439-226044611 | 0 | 0 |
| chr1:226044717-226046896 | 0 | 0 |
| chr1:226047049-226048560 | 0 | 0 |
| chr1:226048697-226049918 | 0 | 0 |
| chr1:226050051-226050155 | 1 | 0 |
| chr1:226050278-226050471 | 0 | 1 |
| chr1:226050551-226053597 | 0 | 0 |
| chr1:226053667-226054274 | 0 | 0 |
| chr1:226054382-226054812 | 0 | 0 |
| chr1:226054863-226055588 | 0 | 0 |
| chr1:226055730-226058776 | 0 | 0 |

| | | |
|--------------------------|--------------------------|---|
| chr1:226058813-226059687 | 0 | 0 |
| chr1:226059753-226061988 | 0 | 0 |
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| chr1:226065294-226066920 | 0 | 0 |
| chr1:226067110-226070004 | 0 | 0 |
| chr1:226050551-226053597 | chr1:226053667-226054274 | |
| chr1:226034633-226034735 | 0 | 0 |
| chr1:226034914-226036193 | 0 | 0 |
| chr1:226036255-226036598 | 0 | 0 |
| chr1:226036713-226037613 | 0 | 0 |
| chr1:226037780-226040365 | 0 | 0 |
| chr1:226040470-226041330 | 0 | 0 |
| chr1:226041492-226043579 | 0 | 0 |
| chr1:226043641-226044353 | 0 | 0 |
| chr1:226044439-226044611 | 0 | 0 |
| chr1:226044717-226046896 | 0 | 0 |
| chr1:226047049-226048560 | 0 | 0 |
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| chr1:226050278-226050471 | 0 | 0 |
| chr1:226050551-226053597 | 1 | 0 |
| chr1:226053667-226054274 | 0 | 1 |
| chr1:226054382-226054812 | 0 | 0 |
| chr1:226054863-226055588 | 0 | 0 |
| chr1:226055730-226058776 | 0 | 0 |
| chr1:226058813-226059687 | 0 | 0 |
| chr1:226059753-226061988 | 0 | 0 |
| chr1:226062067-226065095 | 0 | 0 |
| chr1:226065294-226066920 | 0 | 0 |
| chr1:226067110-226070004 | 0 | 0 |
| chr1:226054382-226054812 | chr1:226054863-226055588 | |
| chr1:226034633-226034735 | 0 | 0 |
| chr1:226034914-226036193 | 0 | 0 |
| chr1:226036255-226036598 | 0 | 0 |
| chr1:226036713-226037613 | 0 | 0 |
| chr1:226037780-226040365 | 0 | 0 |
| chr1:226040470-226041330 | 0 | 0 |
| chr1:226041492-226043579 | 0 | 0 |
| chr1:226043641-226044353 | 0 | 0 |
| chr1:226044439-226044611 | 0 | 0 |
| chr1:226044717-226046896 | 0 | 0 |
| chr1:226047049-226048560 | 0 | 0 |
| chr1:226048697-226049918 | 0 | 0 |
| chr1:226050051-226050155 | 0 | 0 |
| chr1:226050278-226050471 | 0 | 0 |
| chr1:226050551-226053597 | 0 | 0 |
| chr1:226053667-226054274 | 0 | 0 |
| chr1:226054382-226054812 | 1 | 0 |
| chr1:226054863-226055588 | 0 | 1 |
| chr1:226055730-226058776 | 0 | 0 |
| chr1:226058813-226059687 | 0 | 0 |

| | | |
|--------------------------|--------------------------|---|
| chr1:226059753-226061988 | 0 | 0 |
| chr1:226062067-226065095 | 0 | 0 |
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| chr1:226067110-226070004 | 0 | 0 |
| chr1:226055730-226058776 | chr1:226058813-226059687 | |
| chr1:226034633-226034735 | 0 | 0 |
| chr1:226034914-226036193 | 0 | 0 |
| chr1:226036255-226036598 | 0 | 0 |
| chr1:226036713-226037613 | 0 | 0 |
| chr1:226037780-226040365 | 0 | 0 |
| chr1:226040470-226041330 | 0 | 0 |
| chr1:226041492-226043579 | 0 | 0 |
| chr1:226043641-226044353 | 0 | 0 |
| chr1:226044439-226044611 | 0 | 0 |
| chr1:226044717-226046896 | 0 | 0 |
| chr1:226047049-226048560 | 0 | 0 |
| chr1:226048697-226049918 | 0 | 0 |
| chr1:226050051-226050155 | 0 | 0 |
| chr1:226050278-226050471 | 0 | 0 |
| chr1:226050551-226053597 | 0 | 0 |
| chr1:226053667-226054274 | 0 | 0 |
| chr1:226054382-226054812 | 0 | 0 |
| chr1:226054863-226055588 | 0 | 0 |
| chr1:226055730-226058776 | 1 | 0 |
| chr1:226058813-226059687 | 0 | 1 |
| chr1:226059753-226061988 | 0 | 0 |
| chr1:226062067-226065095 | 0 | 0 |
| chr1:226065294-226066920 | 0 | 0 |
| chr1:226067110-226070004 | 0 | 0 |
| chr1:226059753-226061988 | chr1:226062067-226065095 | |
| chr1:226034633-226034735 | 0 | 0 |
| chr1:226034914-226036193 | 0 | 0 |
| chr1:226036255-226036598 | 0 | 0 |
| chr1:226036713-226037613 | 0 | 0 |
| chr1:226037780-226040365 | 0 | 0 |
| chr1:226040470-226041330 | 0 | 0 |
| chr1:226041492-226043579 | 0 | 0 |
| chr1:226043641-226044353 | 0 | 0 |
| chr1:226044439-226044611 | 0 | 0 |
| chr1:226044717-226046896 | 0 | 0 |
| chr1:226047049-226048560 | 0 | 0 |
| chr1:226048697-226049918 | 0 | 0 |
| chr1:226050051-226050155 | 0 | 0 |
| chr1:226050278-226050471 | 0 | 0 |
| chr1:226050551-226053597 | 0 | 0 |
| chr1:226053667-226054274 | 0 | 0 |
| chr1:226054382-226054812 | 0 | 0 |
| chr1:226054863-226055588 | 0 | 0 |
| chr1:226055730-226058776 | 0 | 0 |
| chr1:226058813-226059687 | 0 | 0 |
| chr1:226059753-226061988 | 1 | 0 |

| | | |
|--------------------------|---|---|
| chr1:226062067-226065095 | 0 | 1 |
| chr1:226065294-226066920 | 0 | 0 |
| chr1:226067110-226070004 | 0 | 0 |
| chr1:226034633-226034735 | 0 | 0 |
| chr1:226034914-226036193 | 0 | 0 |
| chr1:226036255-226036598 | 0 | 0 |
| chr1:226036713-226037613 | 0 | 0 |
| chr1:226037780-226040365 | 0 | 0 |
| chr1:226040470-226041330 | 0 | 0 |
| chr1:226041492-226043579 | 0 | 0 |
| chr1:226043641-226044353 | 0 | 0 |
| chr1:226044439-226044611 | 0 | 0 |
| chr1:226044717-226046896 | 0 | 0 |
| chr1:226047049-226048560 | 0 | 0 |
| chr1:226048697-226049918 | 0 | 0 |
| chr1:226050051-226050155 | 0 | 0 |
| chr1:226050278-226050471 | 0 | 0 |
| chr1:226050551-226053597 | 0 | 0 |
| chr1:226053667-226054274 | 0 | 0 |
| chr1:226054382-226054812 | 0 | 0 |
| chr1:226054863-226055588 | 0 | 0 |
| chr1:226055730-226058776 | 0 | 0 |
| chr1:226058813-226059687 | 0 | 0 |
| chr1:226059753-226061988 | 0 | 0 |
| chr1:226062067-226065095 | 0 | 0 |
| chr1:226065294-226066920 | 1 | 0 |
| chr1:226067110-226070004 | 0 | 1 |

\$Rest\$TNFRSF1B

| | | |
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| chr1:12227226-12248853 | 1 | 0 |
| chr1:12248952-12251014 | 0 | 1 |
| chr1:12251142-12251831 | 0 | 0 |
| chr1:12251980-12252488 | 0 | 0 |
| chr1:12252581-12252920 | 0 | 0 |
| chr1:12253155-12254012 | 0 | 0 |
| chr1:12254089-12254641 | 0 | 0 |
| chr1:12254675-12262024 | 0 | 0 |
| chr1:12262228-12266797 | 0 | 0 |
| chr1:12227226-12251014 | 1 | 1 |
| chr1:12251142-12251831 | 1 | 0 |
| chr1:12251980-12252488 | 0 | 1 |
| chr1:12252581-12252920 | 0 | 0 |
| chr1:12253155-12254012 | 0 | 0 |
| chr1:12254089-12254641 | 0 | 0 |
| chr1:12254675-12262024 | 0 | 0 |
| chr1:12262228-12266797 | 0 | 0 |

| | | |
|------------------------|------------------------|------------------------|
| chr1:12227226-12251014 | 0 | 0 |
| | chr1:12252581-12252920 | chr1:12253155-12254012 |
| chr1:12227226-12248853 | 0 | 0 |
| chr1:12248952-12251014 | 0 | 0 |
| chr1:12251142-12251831 | 0 | 0 |
| chr1:12251980-12252488 | 0 | 0 |
| chr1:12252581-12252920 | 1 | 0 |
| chr1:12253155-12254012 | 0 | 1 |
| chr1:12254089-12254641 | 0 | 0 |
| chr1:12254675-12262024 | 0 | 0 |
| chr1:12262228-12266797 | 0 | 0 |
| chr1:12227226-12251014 | 0 | 0 |
| | chr1:12254089-12254641 | chr1:12254675-12262024 |
| chr1:12227226-12248853 | 0 | 0 |
| chr1:12248952-12251014 | 0 | 0 |
| chr1:12251142-12251831 | 0 | 0 |
| chr1:12251980-12252488 | 0 | 0 |
| chr1:12252581-12252920 | 0 | 0 |
| chr1:12253155-12254012 | 0 | 0 |
| chr1:12254089-12254641 | 1 | 0 |
| chr1:12254675-12262024 | 0 | 1 |
| chr1:12262228-12266797 | 0 | 0 |
| chr1:12227226-12251014 | 0 | 0 |
| | chr1:12262228-12266797 | chr1:12227226-12251014 |
| chr1:12227226-12248853 | 0 | 1 |
| chr1:12248952-12251014 | 0 | 1 |
| chr1:12251142-12251831 | 0 | 0 |
| chr1:12251980-12252488 | 0 | 0 |
| chr1:12252581-12252920 | 0 | 0 |
| chr1:12253155-12254012 | 0 | 0 |
| chr1:12254089-12254641 | 0 | 0 |
| chr1:12254675-12262024 | 0 | 0 |
| chr1:12262228-12266797 | 1 | 0 |
| chr1:12227226-12251014 | 0 | 1 |
| \$Rest\$UQCRH | | |
| | chr1:46769492-46774773 | chr1:46774799-46775827 |
| chr1:46769492-46774773 | 1 | 0 |
| chr1:46774799-46775827 | 0 | 1 |
| chr1:46775716-46775827 | 0 | 1 |
| chr1:46775988-46782224 | 0 | 0 |
| chr1:46774799-46775569 | 0 | 1 |
| | chr1:46775716-46775827 | chr1:46775988-46782224 |
| chr1:46769492-46774773 | 0 | 0 |
| chr1:46774799-46775827 | 1 | 0 |
| chr1:46775716-46775827 | 1 | 0 |
| chr1:46775988-46782224 | 0 | 1 |
| chr1:46774799-46775569 | 0 | 0 |
| | chr1:46774799-46775569 | |
| chr1:46769492-46774773 | 0 | |
| chr1:46774799-46775827 | 1 | |

```
chr1:46775716-46775827      0
chr1:46775988-46782224      0
chr1:46774799-46775569      1
```

\$genesJunction

\$genesJunction\$CMPK1

```
[1] "chr1:47799788-47834141" "chr1:47834287-47838627" "chr1:47838779-47840581"
[4] "chr1:47838779-47840869" "chr1:47840657-47840869" "chr1:47840965-47842376"
```

\$genesJunction\$CSF1

```
[1] "chr1:110453684-110456881" "chr1:110457003-110458256" "chr1:110458318-110459915"
[4] "chr1:110460085-110464469" "chr1:110464616-110465788" "chr1:110464616-110466682"
[7] "chr1:110466812-110467398" "chr1:110467450-110467769" "chr1:110467824-110468685"
[10] "chr1:110467824-110471474"
```

\$genesJunction\$FAM72B

```
[1] "chr1:120839865-120841975" "chr1:120839985-120841975" "chr1:120842052-120845995"
[4] "chr1:120846119-120854492"
```

\$genesJunction\$KCNA2

```
[1] "chr1:6046387-6052304"
```

\$genesJunction\$KLHL12

```
[1] "chr1:202861787-202862367" "chr1:202861787-202863312" "chr1:202862553-202863312"
[4] "chr1:202863410-202863719" "chr1:202863877-202864650" "chr1:202863877-202878138"
[7] "chr1:202864845-202865982" "chr1:202866088-202878138" "chr1:202878252-202880182"
[10] "chr1:202880331-202887299" "chr1:202887516-202888883" "chr1:202889036-202894096"
[13] "chr1:202894335-202896217"
```

\$genesJunction\$KLHL21

```
[1] "chr1:6653718-6655545" "chr1:6655617-6659107" "chr1:6659512-6659810"
[4] "chr1:6659512-6661857"
```

\$genesJunction\$LOC105371470

```
[1] "chr1:160709146-160717984" "chr1:160709146-160719611" "chr1:160718304-160719611"
[4] "chr1:160719883-160720094" "chr1:160719922-160720094" "chr1:160720213-160721135"
[7] "chr1:160720213-160721976" "chr1:160721238-160721976" "chr1:160722038-160722896"
```

\$genesJunction\$MIR4632

```
[1] "chr1:12251142-12251831"
```

\$genesJunction\$MYSM1

```
[1] "chr1:59125827-59126842" "chr1:59126899-59127078" "chr1:59127183-59131171"
[4] "chr1:59131303-59132710" "chr1:59132898-59133519" "chr1:59133593-59134102"
[7] "chr1:59133593-59134304" "chr1:59134238-59134656" "chr1:59134354-59134656"
[10] "chr1:59134710-59137542" "chr1:59137630-59139245" "chr1:59139322-59141149"
[13] "chr1:59141252-59142598" "chr1:59142728-59147457" "chr1:59148217-59150825"
[16] "chr1:59150923-59154710" "chr1:59154788-59155898" "chr1:59155921-59156012"
[19] "chr1:59156089-59158533" "chr1:59158603-59160801" "chr1:59160879-59165657"
```

\$genesJunction\$NPHP4

```
[1] "chr1:5923465-5923950" "chr1:5924093-5924398" "chr1:5924577-5925162"
[4] "chr1:5925333-5926433" "chr1:5926518-5927090" "chr1:5927175-5927800"
[7] "chr1:5927956-5933312" "chr1:5933395-5934531" "chr1:5937358-5940174"
[10] "chr1:5940299-5947346" "chr1:5947526-5950928" "chr1:5951088-5964677"
[13] "chr1:5964864-5965352" "chr1:5965543-5965692" "chr1:5965843-5967175"
[16] "chr1:5967282-5969212" "chr1:5969273-5987709" "chr1:5987847-5993207"
[19] "chr1:5993389-6007164" "chr1:6007290-6008130" "chr1:6008311-6012760"
[22] "chr1:6012896-6021854" "chr1:6022009-6027359" "chr1:6027423-6029147"
[25] "chr1:6029319-6038330" "chr1:6038473-6046215" "chr1:6046387-6052304"
[28] "chr1:5934717-5934934" "chr1:5965840-5967175" "chr1:5936583-5937153"
[31] "chr1:5937358-5939406" "chr1:5939692-5940174"
```

\$genesJunction\$PEX14

```
[1] "chr1:10637247-10637871" "chr1:10659423-10678389" "chr1:10678474-10683076"
[4] "chr1:10683178-10684397" "chr1:10684494-10687329" "chr1:10687420-10689588"
[7] "chr1:10596354-10659295" "chr1:10596354-10678389"
```

\$genesJunction\$PIP5K1A

```
[1] "chr1:151171557-151196721" "chr1:151171557-151196724" "chr1:151196755-151199796"
[4] "chr1:151199876-151204147" "chr1:151204277-151204724" "chr1:151204841-151205027"
[7] "chr1:151205179-151206673" "chr1:151206972-151209034" "chr1:151209239-151210658"
[10] "chr1:151209239-151211606" "chr1:151210741-151211606" "chr1:151211654-151212431"
[13] "chr1:151212515-151214599" "chr1:151212515-151219396" "chr1:151214745-151214914"
[16] "chr1:151215043-151219396" "chr1:151219441-151220339" "chr1:151196755-151196847"
[19] "chr1:151196882-151199796" "chr1:151212515-151214914"
```

\$genesJunction\$PSMB2

```
[1] "chr1:36068975-36070834" "chr1:36070883-36074847" "chr1:36075009-36096875"
[4] "chr1:36096945-36101911" "chr1:36102033-36106943" "chr1:36043093-36070834"
```

\$genesJunction\$RBBP4

```
[1] "chr1:33116923-33117515" "chr1:33117662-33123028" "chr1:33123173-33133826"
[4] "chr1:33133999-33134340" "chr1:33134455-33134573" "chr1:33134733-33134832"
[7] "chr1:33134958-33135087" "chr1:33135164-33138051" "chr1:33138127-33138243"
[10] "chr1:33138300-33138392" "chr1:33138502-33145241" "chr1:33116923-33117518"
```

\$genesJunction\$RBBP5

```
[1] "chr1:205057943-205064001" "chr1:205057943-205064115" "chr1:205064192-205065810"
[4] "chr1:205066039-205066454" "chr1:205066523-205068117" "chr1:205068234-205068869"
[7] "chr1:205068940-205069039" "chr1:205069192-205069280" "chr1:205069399-205070728"
[10] "chr1:205070837-205072985" "chr1:205073147-205074156" "chr1:205074296-205083917"
[13] "chr1:205084033-205084986" "chr1:205084089-205084986" "chr1:205085011-205090983"
[16] "chr1:205057940-205064001"
```

\$genesJunction\$RERE

```
[1] "chr1:8415180-8415479" "chr1:8415659-8416160" "chr1:8416306-8418256"
[4] "chr1:8418976-8419824" "chr1:8420046-8420172" "chr1:8421550-8421823"
[7] "chr1:8421936-8422743" "chr1:8422904-8424116" "chr1:8424315-8424806"
[10] "chr1:8424898-8425872" "chr1:8426034-8482787" "chr1:8482867-8525985"
[13] "chr1:8526083-8555123" "chr1:8555222-8557465" "chr1:8557589-8568686"
```

```
[16] "chr1:8568734-8601273" "chr1:8601377-8616534" "chr1:8616630-8617477"
[19] "chr1:8617582-8674620" "chr1:8674745-8684369" "chr1:8684439-8716032"
[22] "chr1:8716500-8813490" "chr1:8716500-8877219" "chr1:8482867-8483621"
[25] "chr1:8852647-8877219" "chr1:8716500-8852463"
```

```
$genesJunction$`RERE-AS1`
[1] "chr1:8482867-8525985"
```

```
$genesJunction$SLAMF7
[1] "chr1:160709146-160717984" "chr1:160709146-160719611" "chr1:160718304-160719611"
[4] "chr1:160719883-160720094" "chr1:160719922-160720094" "chr1:160720213-160721135"
[7] "chr1:160720213-160721976" "chr1:160721238-160721976" "chr1:160722038-160722896"
```

```
$genesJunction$SLC41A1
[1] "chr1:205760846-205763998" "chr1:205764146-205764472" "chr1:205764606-205766052"
[4] "chr1:205766131-205767032" "chr1:205767179-205767797" "chr1:205767943-205768085"
[7] "chr1:205768229-205768887" "chr1:205768958-205770081" "chr1:205770188-205779198"
[10] "chr1:205780215-205781936"
```

```
$genesJunction$TFAP2E
[1] "chr1:36040299-36042923" "chr1:36043093-36070834"
```

```
$genesJunction$`TFAP2E-AS1`
[1] "chr1:36040299-36042923" "chr1:36043093-36070834"
```

```
$genesJunction$TMEM51
[1] "chr1:15479280-15541391" "chr1:15480450-15541391" "chr1:15541927-15545822"
[4] "chr1:15480450-15536986" "chr1:15537058-15541391"
```

```
$genesJunction$`TMEM51-AS1`
[1] "chr1:15479280-15541391"
```

```
$genesJunction$`TMEM51-AS2`
[1] "chr1:15479280-15541391" "chr1:15480450-15541391" "chr1:15480450-15536986"
```

```
$genesJunction$TMEM63A
[1] "chr1:226034633-226034735" "chr1:226034914-226036193" "chr1:226036255-226036598"
[4] "chr1:226036713-226037613" "chr1:226037780-226040365" "chr1:226040470-226041330"
[7] "chr1:226041492-226043579" "chr1:226043641-226044353" "chr1:226044439-226044611"
[10] "chr1:226044717-226046896" "chr1:226047049-226048560" "chr1:226048697-226049918"
[13] "chr1:226050051-226050155" "chr1:226050278-226050471" "chr1:226050551-226053597"
[16] "chr1:226053667-226054274" "chr1:226054382-226054812" "chr1:226054863-226055588"
[19] "chr1:226055730-226058776" "chr1:226058813-226059687" "chr1:226059753-226061988"
[22] "chr1:226062067-226065095" "chr1:226065294-226066920" "chr1:226067110-226070004"
```

```
$genesJunction$TNFRSF1B
[1] "chr1:12227226-12248853" "chr1:12248952-12251014" "chr1:12251142-12251831"
[4] "chr1:12251980-12252488" "chr1:12252581-12252920" "chr1:12253155-12254012"
[7] "chr1:12254089-12254641" "chr1:12254675-12262024" "chr1:12262228-12266797"
[10] "chr1:12227226-12251014"
```

\$genesJunction\$UQCRH

[1] "chr1:46769492-46774773" "chr1:46774799-46775827" "chr1:46775716-46775827"
[4] "chr1:46775988-46782224" "chr1:46774799-46775569"

\$juncexpressed

[1] "chr1:47799788-47834141" "chr1:47834287-47838627"
[3] "chr1:47838779-47840581" "chr1:47838779-47840869"
[5] "chr1:47840657-47840869" "chr1:47840965-47842376"
[7] "chr1:110453684-110456881" "chr1:110457003-110458256"
[9] "chr1:110458318-110459915" "chr1:110460085-110464469"
[11] "chr1:110464616-110465788" "chr1:110464616-110466682"
[13] "chr1:110466812-110467398" "chr1:110467450-110467769"
[15] "chr1:110467824-110468685" "chr1:110467824-110471474"
[17] "chr1:120839865-120841975" "chr1:120839985-120841975"
[19] "chr1:120842052-120845995" "chr1:120846119-120854492"
[21] "chr1:202861787-202862367" "chr1:202861787-202863312"
[23] "chr1:202862553-202863312" "chr1:202863410-202863719"
[25] "chr1:202863877-202864650" "chr1:202863877-202878138"
[27] "chr1:202864845-202865982" "chr1:202866088-202878138"
[29] "chr1:202878252-202880182" "chr1:202880331-202887299"
[31] "chr1:202887516-202888883" "chr1:202889036-202894096"
[33] "chr1:202894335-202896217" "chr1:6653718-6655545"
[35] "chr1:6655617-6659107" "chr1:6659512-6659810"
[37] "chr1:6659512-6661857" "chr1:59125827-59126842"
[39] "chr1:59126899-59127078" "chr1:59127183-59131171"
[41] "chr1:59131303-59132710" "chr1:59132898-59133519"
[43] "chr1:59133593-59134102" "chr1:59133593-59134304"
[45] "chr1:59134238-59134656" "chr1:59134354-59134656"
[47] "chr1:59134710-59137542" "chr1:59137630-59139245"
[49] "chr1:59139322-59141149" "chr1:59141252-59142598"
[51] "chr1:59142728-59147457" "chr1:59148217-59150825"
[53] "chr1:59150923-59154710" "chr1:59154788-59155898"
[55] "chr1:59155921-59156012" "chr1:59156089-59158533"
[57] "chr1:59158603-59160801" "chr1:59160879-59165657"
[59] "chr1:5923465-5923950" "chr1:5924093-5924398"
[61] "chr1:5924577-5925162" "chr1:5925333-5926433"
[63] "chr1:5926518-5927090" "chr1:5927175-5927800"
[65] "chr1:5927956-5933312" "chr1:5933395-5934531"
[67] "chr1:5937358-5940174" "chr1:5940299-5947346"
[69] "chr1:5947526-5950928" "chr1:5951088-5964677"
[71] "chr1:5964864-5965352" "chr1:5965543-5965692"
[73] "chr1:5965843-5967175" "chr1:5967282-5969212"
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[77] "chr1:5993389-6007164" "chr1:6007290-6008130"
[79] "chr1:6008311-6012760" "chr1:6012896-6021854"
[81] "chr1:6022009-6027359" "chr1:6027423-6029147"
[83] "chr1:6029319-6038330" "chr1:6038473-6046215"
[85] "chr1:6046387-6052304" "chr1:5934717-5934934"
[87] "chr1:5965840-5967175" "chr1:5936583-5937153"
[89] "chr1:5937358-5939406" "chr1:5939692-5940174"

| | | |
|-------|----------------------------|----------------------------|
| [91] | "chr1:10637247-10637871" | "chr1:10659423-10678389" |
| [93] | "chr1:10678474-10683076" | "chr1:10683178-10684397" |
| [95] | "chr1:10684494-10687329" | "chr1:10687420-10689588" |
| [97] | "chr1:10596354-10659295" | "chr1:10596354-10678389" |
| [99] | "chr1:151171557-151196721" | "chr1:151171557-151196724" |
| [101] | "chr1:151196755-151199796" | "chr1:151199876-151204147" |
| [103] | "chr1:151204277-151204724" | "chr1:151204841-151205027" |
| [105] | "chr1:151205179-151206673" | "chr1:151206972-151209034" |
| [107] | "chr1:151209239-151210658" | "chr1:151209239-151211606" |
| [109] | "chr1:151210741-151211606" | "chr1:151211654-151212431" |
| [111] | "chr1:151212515-151214599" | "chr1:151212515-151219396" |
| [113] | "chr1:151214745-151214914" | "chr1:151215043-151219396" |
| [115] | "chr1:151219441-151220339" | "chr1:151196755-151196847" |
| [117] | "chr1:151196882-151199796" | "chr1:151212515-151214914" |
| [119] | "chr1:36040299-36042923" | "chr1:36068975-36070834" |
| [121] | "chr1:36070883-36074847" | "chr1:36075009-36096875" |
| [123] | "chr1:36096945-36101911" | "chr1:36102033-36106943" |
| [125] | "chr1:36043093-36070834" | "chr1:33116923-33117515" |
| [127] | "chr1:33117662-33123028" | "chr1:33123173-33133826" |
| [129] | "chr1:33133999-33134340" | "chr1:33134455-33134573" |
| [131] | "chr1:33134733-33134832" | "chr1:33134958-33135087" |
| [133] | "chr1:33135164-33138051" | "chr1:33138127-33138243" |
| [135] | "chr1:33138300-33138392" | "chr1:33138502-33145241" |
| [137] | "chr1:33116923-33117518" | "chr1:205057943-205064001" |
| [139] | "chr1:205057943-205064115" | "chr1:205064192-205065810" |
| [141] | "chr1:205066039-205066454" | "chr1:205066523-205068117" |
| [143] | "chr1:205068234-205068869" | "chr1:205068940-205069039" |
| [145] | "chr1:205069192-205069280" | "chr1:205069399-205070728" |
| [147] | "chr1:205070837-205072985" | "chr1:205073147-205074156" |
| [149] | "chr1:205074296-205083917" | "chr1:205084033-205084986" |
| [151] | "chr1:205084089-205084986" | "chr1:205085011-205090983" |
| [153] | "chr1:205057940-205064001" | "chr1:8415180-8415479" |
| [155] | "chr1:8415659-8416160" | "chr1:8416306-8418256" |
| [157] | "chr1:8418976-8419824" | "chr1:8420046-8420172" |
| [159] | "chr1:8421550-8421823" | "chr1:8421936-8422743" |
| [161] | "chr1:8422904-8424116" | "chr1:8424315-8424806" |
| [163] | "chr1:8424898-8425872" | "chr1:8426034-8482787" |
| [165] | "chr1:8482867-8525985" | "chr1:8526083-8555123" |
| [167] | "chr1:8555222-8557465" | "chr1:8557589-8568686" |
| [169] | "chr1:8568734-8601273" | "chr1:8601377-8616534" |
| [171] | "chr1:8616630-8617477" | "chr1:8617582-8674620" |
| [173] | "chr1:8674745-8684369" | "chr1:8684439-8716032" |
| [175] | "chr1:8716500-8813490" | "chr1:8716500-8877219" |
| [177] | "chr1:8482867-8483621" | "chr1:8852647-8877219" |
| [179] | "chr1:8716500-8852463" | "chr1:160709146-160717984" |
| [181] | "chr1:160709146-160719611" | "chr1:160718304-160719611" |
| [183] | "chr1:160719883-160720094" | "chr1:160719922-160720094" |
| [185] | "chr1:160720213-160721135" | "chr1:160720213-160721976" |
| [187] | "chr1:160721238-160721976" | "chr1:160722038-160722896" |
| [189] | "chr1:205760846-205763998" | "chr1:205764146-205764472" |
| [191] | "chr1:205764606-205766052" | "chr1:205766131-205767032" |


```

[193] "chr1:205767179-205767797" "chr1:205767943-205768085"
[195] "chr1:205768229-205768887" "chr1:205768958-205770081"
[197] "chr1:205770188-205779198" "chr1:205780215-205781936"
[199] "chr1:15479280-15541391" "chr1:15480450-15541391"
[201] "chr1:15541927-15545822" "chr1:15480450-15536986"
[203] "chr1:15537058-15541391" "chr1:226034633-226034735"
[205] "chr1:226034914-226036193" "chr1:226036255-226036598"
[207] "chr1:226036713-226037613" "chr1:226037780-226040365"
[209] "chr1:226040470-226041330" "chr1:226041492-226043579"
[211] "chr1:226043641-226044353" "chr1:226044439-226044611"
[213] "chr1:226044717-226046896" "chr1:226047049-226048560"
[215] "chr1:226048697-226049918" "chr1:226050051-226050155"
[217] "chr1:226050278-226050471" "chr1:226050551-226053597"
[219] "chr1:226053667-226054274" "chr1:226054382-226054812"
[221] "chr1:226054863-226055588" "chr1:226055730-226058776"
[223] "chr1:226058813-226059687" "chr1:226059753-226061988"
[225] "chr1:226062067-226065095" "chr1:226065294-226066920"
[227] "chr1:226067110-226070004" "chr1:12227226-12248853"
[229] "chr1:12248952-12251014" "chr1:12251142-12251831"
[231] "chr1:12251980-12252488" "chr1:12252581-12252920"
[233] "chr1:12253155-12254012" "chr1:12254089-12254641"
[235] "chr1:12254675-12262024" "chr1:12262228-12266797"
[237] "chr1:12227226-12251014" "chr1:46769492-46774773"
[239] "chr1:46774799-46775827" "chr1:46775716-46775827"
[241] "chr1:46775988-46782224" "chr1:46774799-46775569"

```

```
> print(overlapMat[["Rest"]][["CMPK1"]])
```

```

          chr1:47799788-47834141 chr1:47834287-47838627
chr1:47799788-47834141          1          0
chr1:47834287-47838627          0          1
chr1:47838779-47840581          0          0
chr1:47838779-47840869          0          0
chr1:47840657-47840869          0          0
chr1:47840965-47842376          0          0
          chr1:47838779-47840581 chr1:47838779-47840869
chr1:47799788-47834141          0          0
chr1:47834287-47838627          0          0
chr1:47838779-47840581          1          1
chr1:47838779-47840869          1          1
chr1:47840657-47840869          0          1
chr1:47840965-47842376          0          0
          chr1:47840657-47840869 chr1:47840965-47842376
chr1:47799788-47834141          0          0
chr1:47834287-47838627          0          0
chr1:47838779-47840581          0          0
chr1:47838779-47840869          1          0
chr1:47840657-47840869          1          0
chr1:47840965-47842376          0          1
          chr1:47799788-47834141 chr1:47834287-47838627
chr1:47799788-47834141          1          0
chr1:47834287-47838627          0          1

```

```

chr1:47838779-47840581      0      0
chr1:47838779-47840869      0      0
chr1:47840657-47840869      0      0
chr1:47840965-47842376      0      0
      chr1:47838779-47840581 chr1:47838779-47840869
chr1:47799788-47834141      0      0
chr1:47834287-47838627      0      0
chr1:47838779-47840581      1      1
chr1:47838779-47840869      1      1
chr1:47840657-47840869      0      1
chr1:47840965-47842376      0      0
      chr1:47840657-47840869 chr1:47840965-47842376
chr1:47799788-47834141      0      0
chr1:47834287-47838627      0      0
chr1:47838779-47840581      0      0
chr1:47838779-47840869      1      0
chr1:47840657-47840869      1      0
chr1:47840965-47842376      0      1
>

```

Another important function is kendall- τ restricted.

```

> V <- cbind(c(1,5,3),c(3,2,1))

      [,1] [,2]
[1,]    1    3
[2,]    5    2
[3,]    3    1

> rownames(V) <- c("F1","F2","F3")

[1] "F1" "F2" "F3"

> colnames(V) <- c("S1","S2")

[1] "S1" "S2"

> GSReg.kendall.tau.distance(V)

      S1      S2
S1 0.0000000 0.6666667
S2 0.6666667 0.0000000

> myRest1 <- cbind(c(0,1,1),c(1,0,1),c(1,1,0))

      [,1] [,2] [,3]
[1,]    0    1    1
[2,]    1    0    1
[3,]    1    1    0

> rownames(myRest1) <- rownames(V)

[1] "F1" "F2" "F3"

```

```

> colnames(myRest1) <- rownames(V)

[1] "F1" "F2" "F3"

> GSReg.kendall.tau.distance.restricted(V,myRest1)

      S1      S2
S1 0.0000000 0.6666666
S2 0.6666666 0.0000000

> GSReg.kendall.tau.distance(V)

      S1      S2
S1 0.0000000 0.6666667
S2 0.6666667 0.0000000

> myRest2 <- cbind(c(0,0,1),c(0,0,1),c(1,1,0))

      [,1] [,2] [,3]
[1,]    0    0    1
[2,]    0    0    1
[3,]    1    1    0

> rownames(myRest2) <- rownames(V)

[1] "F1" "F2" "F3"

> colnames(myRest2) <- rownames(V)

[1] "F1" "F2" "F3"

> GSReg.kendall.tau.distance.restricted(V,myRest2)

      S1      S2
S1 0.0000000 0.4999999
S2 0.4999999 0.0000000

> Temp1 <- cbind(c(0,1,1),c(0,0,0),c(0,1,0))

      [,1] [,2] [,3]
[1,]    0    0    0
[2,]    1    0    1
[3,]    1    0    0

> rownames(Temp1) <- rownames(V)

[1] "F1" "F2" "F3"

> colnames(Temp1) <- rownames(V)

[1] "F1" "F2" "F3"

> GSReg.kendall.tau.distance.template(V,Temp = Temp1)

      S1      S2
1.0000000 0.3333333

```

Now, we can use SEVA function and use the data from the paper [?].

```
> data(juncExprsSimulated)
> SEVAjunc <- GSReg.SEVA(juncExprs = junc.RPM.Simulated,
                        phenoVect = phenotypes,
                        geneexpr = geneExrsGSReg)
> print(sapply(SEVAjunc,function(x) x$pvalue))
```

| CMPK1 | CSF1 | FAM72B | KLHL12 | KLHL21 | LOC105371470 |
|------------|------------|------------|------------|------------|--------------|
| 1.00000000 | 1.00000000 | 0.00000000 | 0.00000000 | 0.19089848 | 0.00000000 |
| MYSM1 | NPHP4 | PEX14 | PIP5K1A | PSMB2 | RBBP4 |
| 0.00000000 | 0.53048443 | 0.81734872 | 0.00000000 | 1.00000000 | 0.00000000 |
| RBBP5 | RERE | SLAMF7 | SLC41A1 | TMEM51 | TMEM51-AS2 |
| 0.07123363 | 0.29801755 | 0.00000000 | 1.00000000 | 0.09424228 | 0.06777388 |
| TMEM63A | TNFRSF1B | UQCRH | | | |
| 1.00000000 | 1.00000000 | 0.00000000 | | | |

```
> #if you want to check Translational as well you can use 2 other p-values
> print(sapply(SEVAjunc,function(x) x$pvalueTotal))
```

| CMPK1 | CSF1 | FAM72B | KLHL12 | KLHL21 | LOC105371470 |
|------------|------------|------------|------------|------------|--------------|
| 1.00000000 | 1.00000000 | 0.00000000 | 0.00000000 | 0.26032517 | 0.00000000 |
| MYSM1 | NPHP4 | PEX14 | PIP5K1A | PSMB2 | RBBP4 |
| 0.00000000 | 1.00000000 | 1.00000000 | 0.00000000 | 1.00000000 | 0.00000000 |
| RBBP5 | RERE | SLAMF7 | SLC41A1 | TMEM51 | TMEM51-AS2 |
| 0.02343778 | 0.89405265 | 0.00000000 | 1.00000000 | 0.17473402 | 0.14516649 |
| TMEM63A | TNFRSF1B | UQCRH | | | |
| 1.00000000 | 1.00000000 | 0.00000000 | | | |

```
>
```

4 System Information

Session information:

```
> toLatex(sessionInfo())
```

- R version 4.5.1 Patched (2025-09-10 r88807), aarch64-apple-darwin20
- Locale: C/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8
- Time zone: America/New_York
- TZcode source: internal
- Running under: macOS Ventura 13.7.7
- Matrix products: default
- BLAS:
/Library/Frameworks/R.framework/Versions/4.5-arm64/Resources/lib/libRblas.dylib
- LAPACK:
/Library/Frameworks/R.framework/Versions/4.5-arm64/Resources/lib/libRlapack.dylib;
LAPACK version 3.12.1
- Base packages: base, datasets, grDevices, graphics, methods, stats, stats4, utils
- Other packages: AnnotationDbi 1.72.0, Biobase 2.70.0, BiocGenerics 0.56.0, GO.db 3.22.0, GSBenchMark 1.29.0, GSReg 1.44.0, GenomicFeatures 1.62.0, GenomicRanges 1.62.0, Homo.sapiens 1.3.1, IRanges 2.44.0, OrganismDbi 1.52.0, S4Vectors 0.48.0, Seqinfo 1.0.0, TxDb.Hsapiens.UCSC.hg19.knownGene 3.22.1, generics 0.1.4, org.Hs.eg.db 3.22.0
- Loaded via a namespace (and not attached): BiocIO 1.20.0, BiocManager 1.30.26, BiocParallel 1.44.0, Biostrings 2.78.0, DBI 1.2.3, DelayedArray 0.36.0, GenomicAlignments 1.46.0, KEGGREST 1.50.0, Matrix 1.7-4, MatrixGenerics 1.22.0, R6 2.6.1, RBGL 1.86.0, RCurl 1.98-1.17, RSQLite 2.4.3, Rsamtools 2.26.0, S4Arrays 1.10.0, SparseArray 1.10.0, SummarizedExperiment 1.40.0, XML 3.99-0.19, XVector 0.50.0, abind 1.4-8, bit 4.6.0, bit64 4.6.0-1, bitops 1.0-9, blob 1.2.4, cachem 1.1.0, cigarillo 1.0.0, cli 3.6.5, codetools 0.2-20, compiler 4.5.1, crayon 1.5.3, curl 7.0.0, fastmap 1.2.0, graph 1.88.0, grid 4.5.1, httr 1.4.7, lattice 0.22-7, matrixStats 1.5.0, memoise 2.0.1, parallel 4.5.1, pkgconfig 2.0.3, png 0.1-8, restfulr 0.0.16, rjson 0.2.23, rlang 1.1.6, rtracklayer 1.70.0, tools 4.5.1, vctrs 0.6.5, yaml 2.3.10

5 Literature Cited

References

- [1] James A Eddy, Leroy Hood, Nathan D Price, and Donald Geman. Identifying tightly regulated and variably expressed networks by differential rank conservation (dirac). *PLoS computational biology*, 6(5):e1000792, 2010.
- [2] Bahman Afsari. *Modeling cancer phenotypes with order statistics of transcript data*. PhD thesis, Johns Hopkins University, 2013.
- [3] Maurice G Kendall. A new measure of rank correlation. *Biometrika*, 1938.