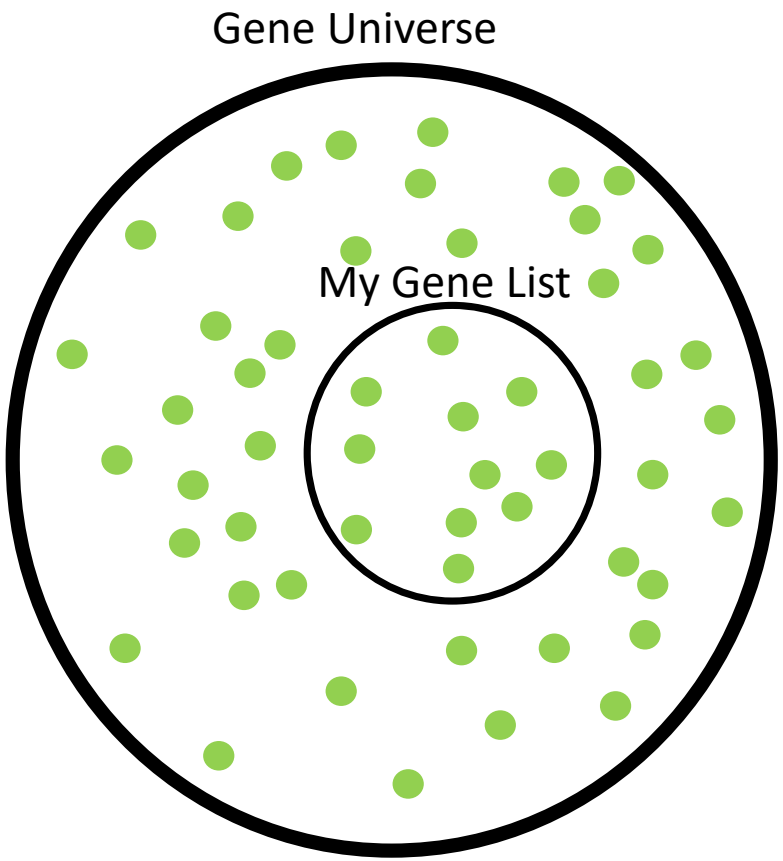
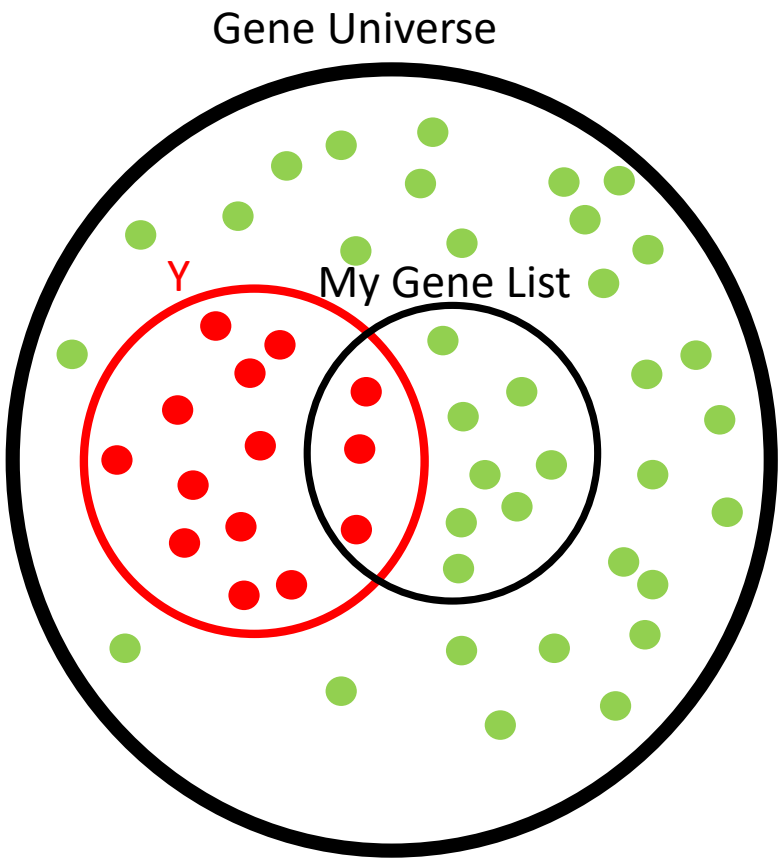
Overrepresentation Test



Overrepresentation Test

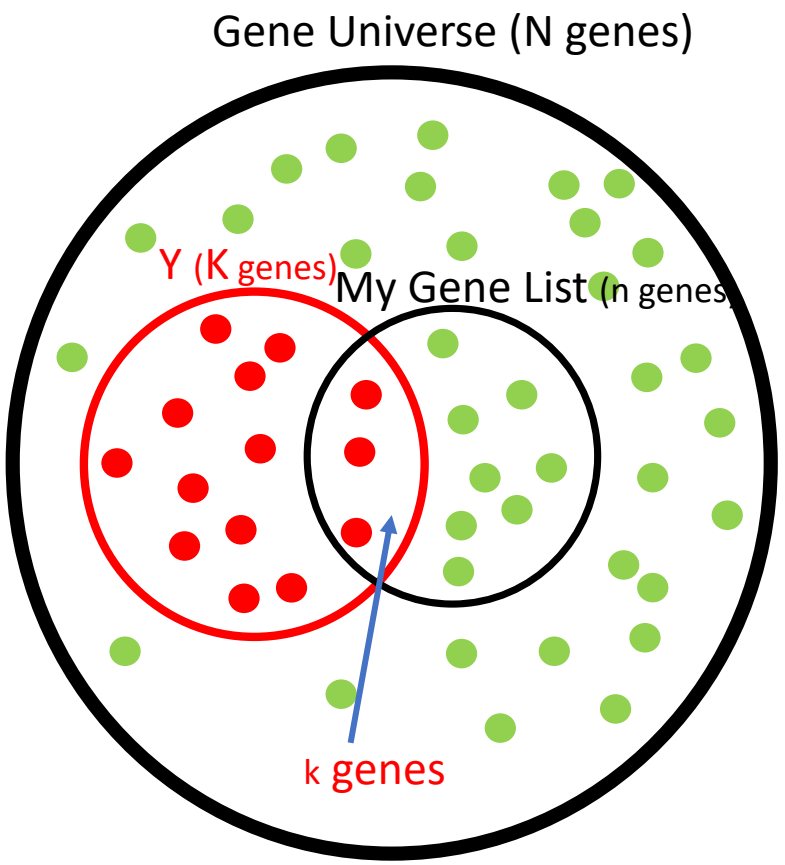


A subset of genes are annotated with category Y

My Gene List has 11 genes and 3 are annotated with category Y.

Are category Y genes overrepresented in My Gene List?

Overrepresentation Test



A subset of genes are annotated with category Y

My Gene List has 11 genes and 3 are annotated with category Y.

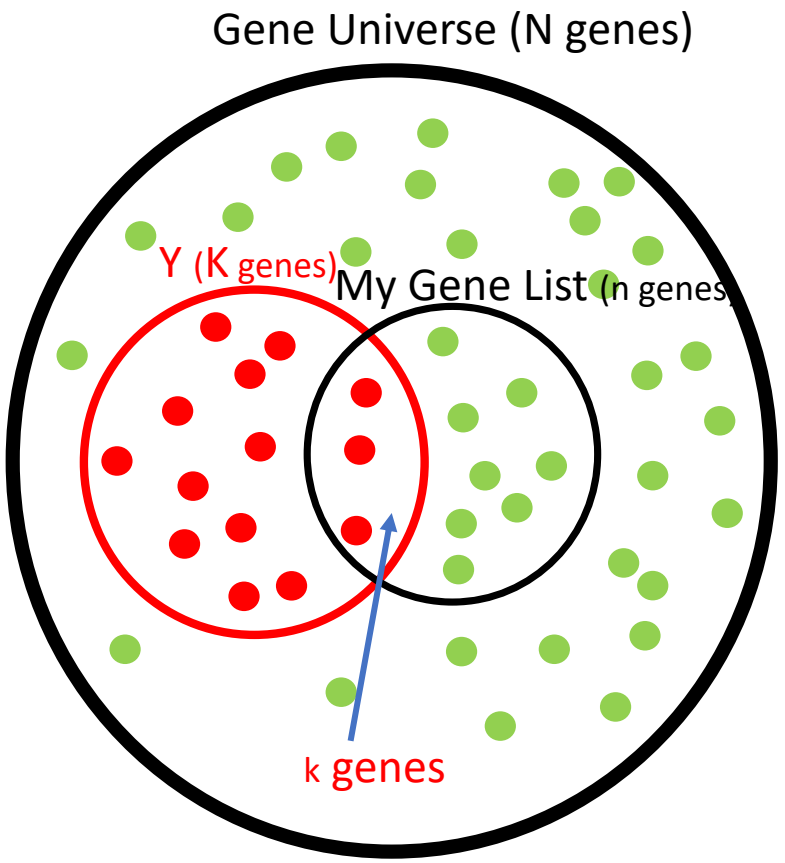
Are category Y genes overrepresented in My Gene List?

Hypergeometric Distribution

Probability of My Gene List having k red genes if it is a random sample of size **n** from the Gene Universe (size **N**)

$$P(X = k) = \frac{\binom{K}{k}\binom{N-K}{n-k}}{\binom{N}{n}}$$

Overrepresentation Test



A subset of genes are annotated with category Y

My Gene List has 11 genes and 3 are annotated with category Y.

Are category Y genes overrepresented in My Gene List?

Hypergeometric Distribution

Probability of My Gene List having k red genes if it is a random sample of size n from the Gene Universe (size N)

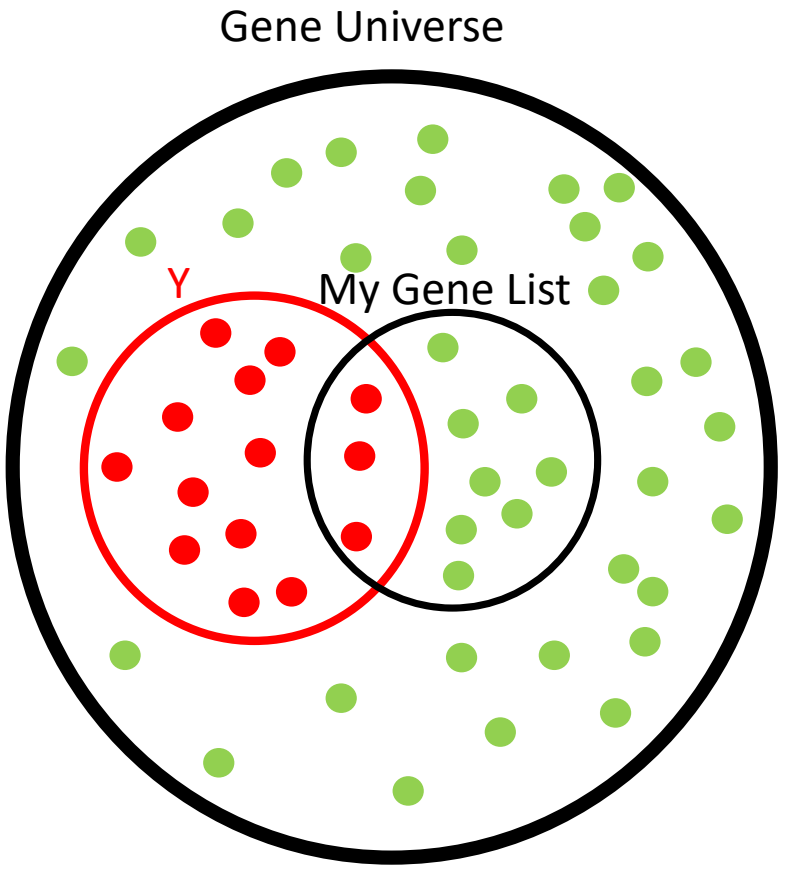
$$P(X=k)=\frac{\binom{K}{k}\binom{N-K}{n-k}}{\binom{N}{n}}$$

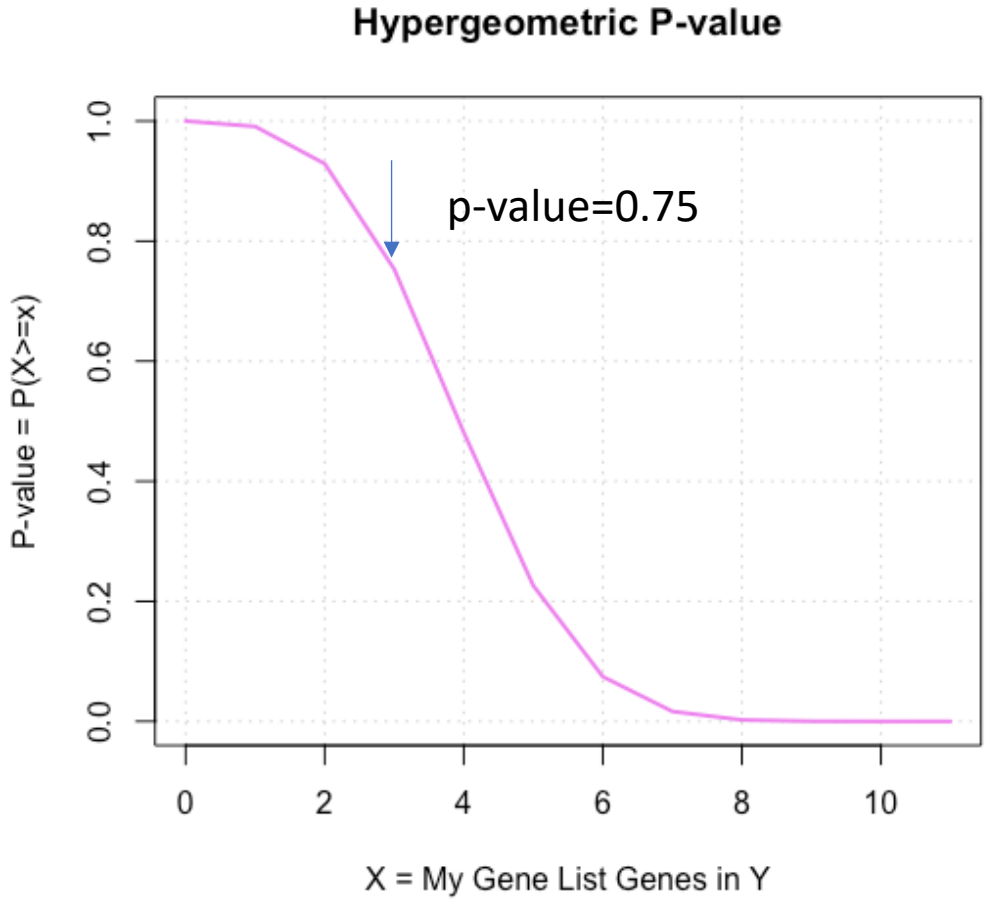
P-value: Probability of having k or more red genes by chance:

If this is small, our result is significant

$$P(X\geq k\,|\,n;N;K)=\sum_{i=k}^{n}\frac{\binom{K}{i}\binom{N-K}{n-i}}{\binom{N}{n}}$$

Overrepresentation Test



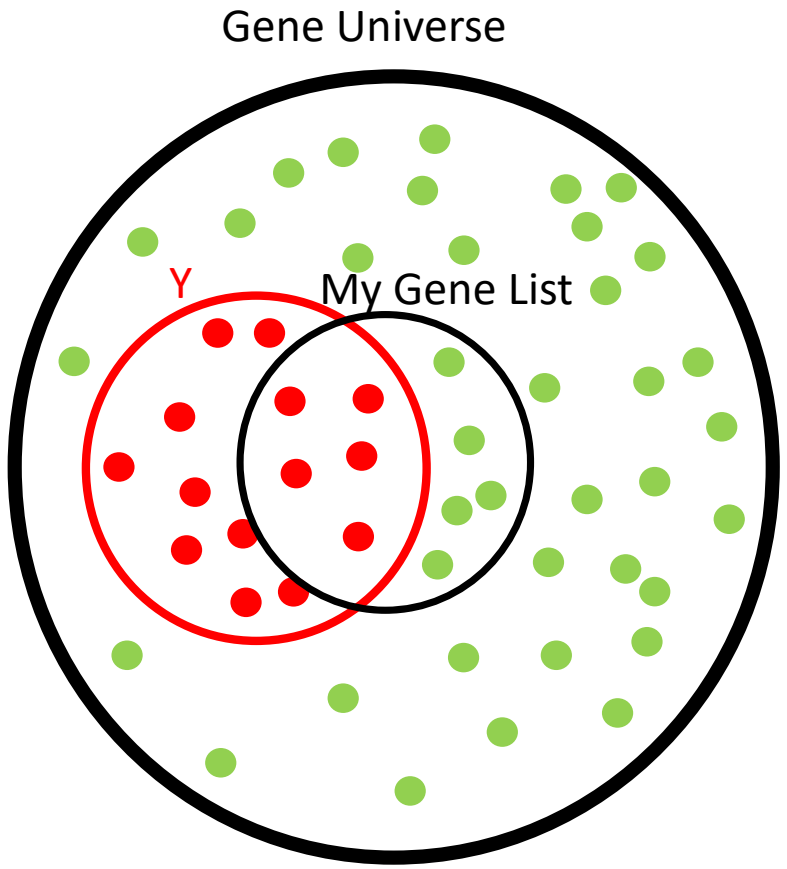


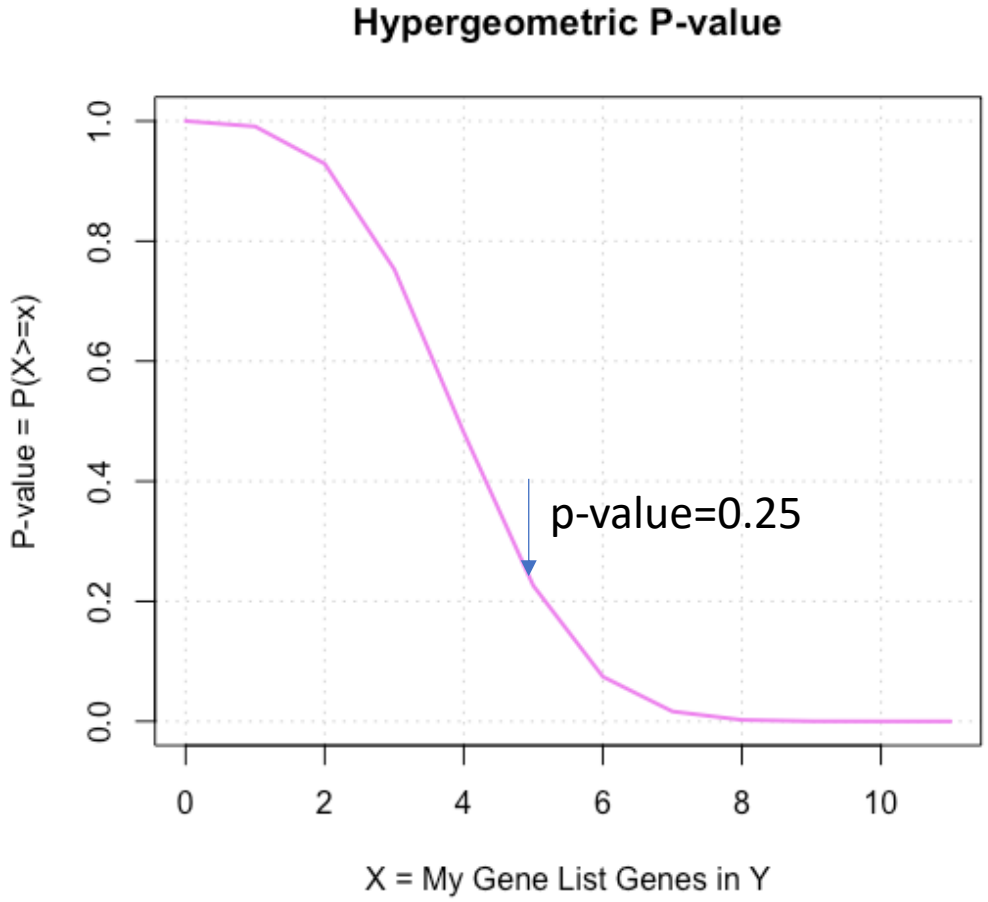
P-value: Probability of having k or more red genes by chance:

If this is small, our result is significant

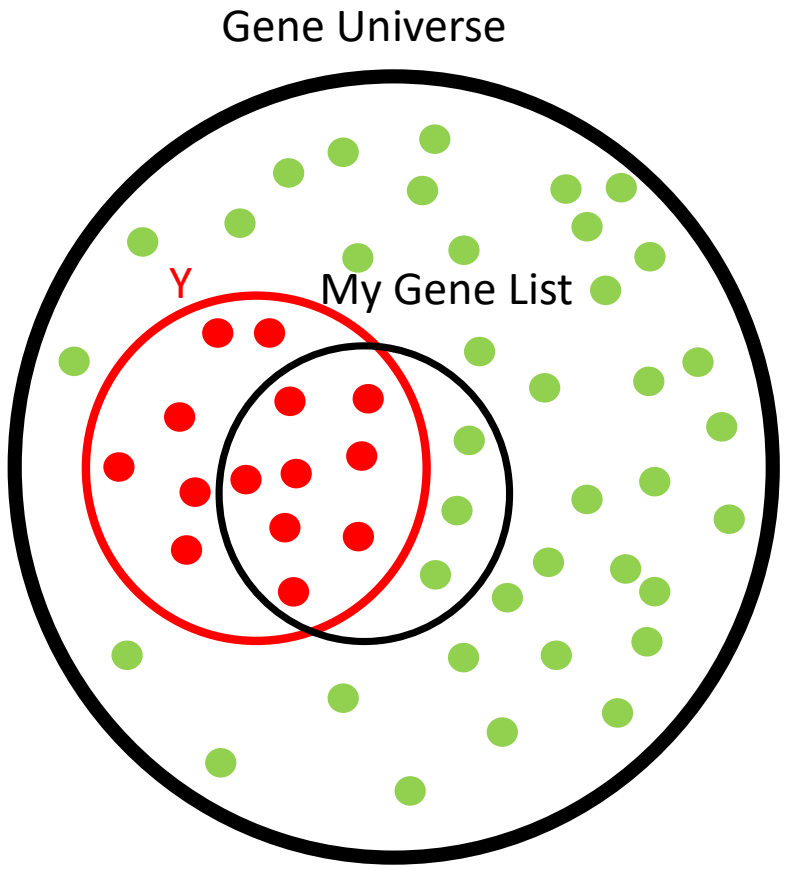
$$P(X \geq k \mid n; N; K) = \sum_{i=k}^{n} \frac{\binom{K}{i}\binom{N-K}{n-i}}{\binom{N}{n}}$$

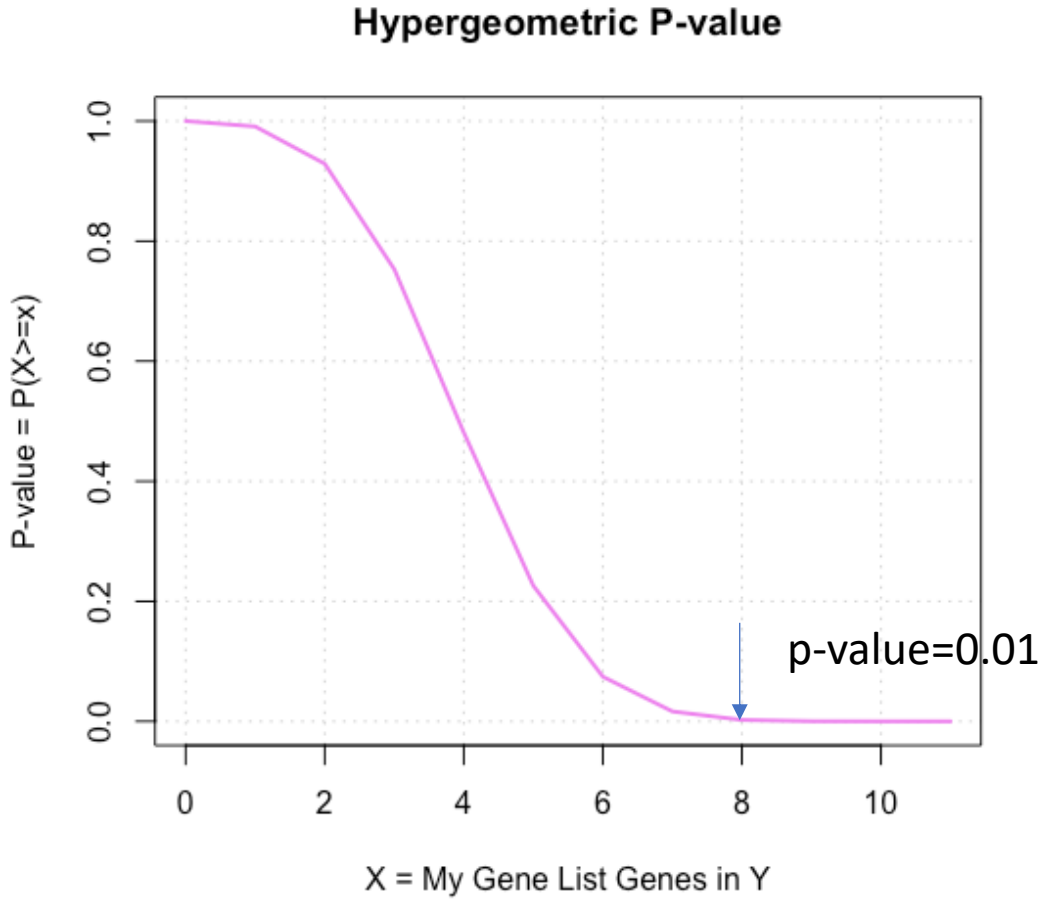
Overrepresentation Test





Overrepresentation Test





GO Enrichment with ClusterProfiler (R)

```
ego = enrichGO(geneList,
               OrgDb,
               ont = 'BP',
               pvalueCutoff = 0.05)
```

Fraction of genes in My Gene List with the Annotation

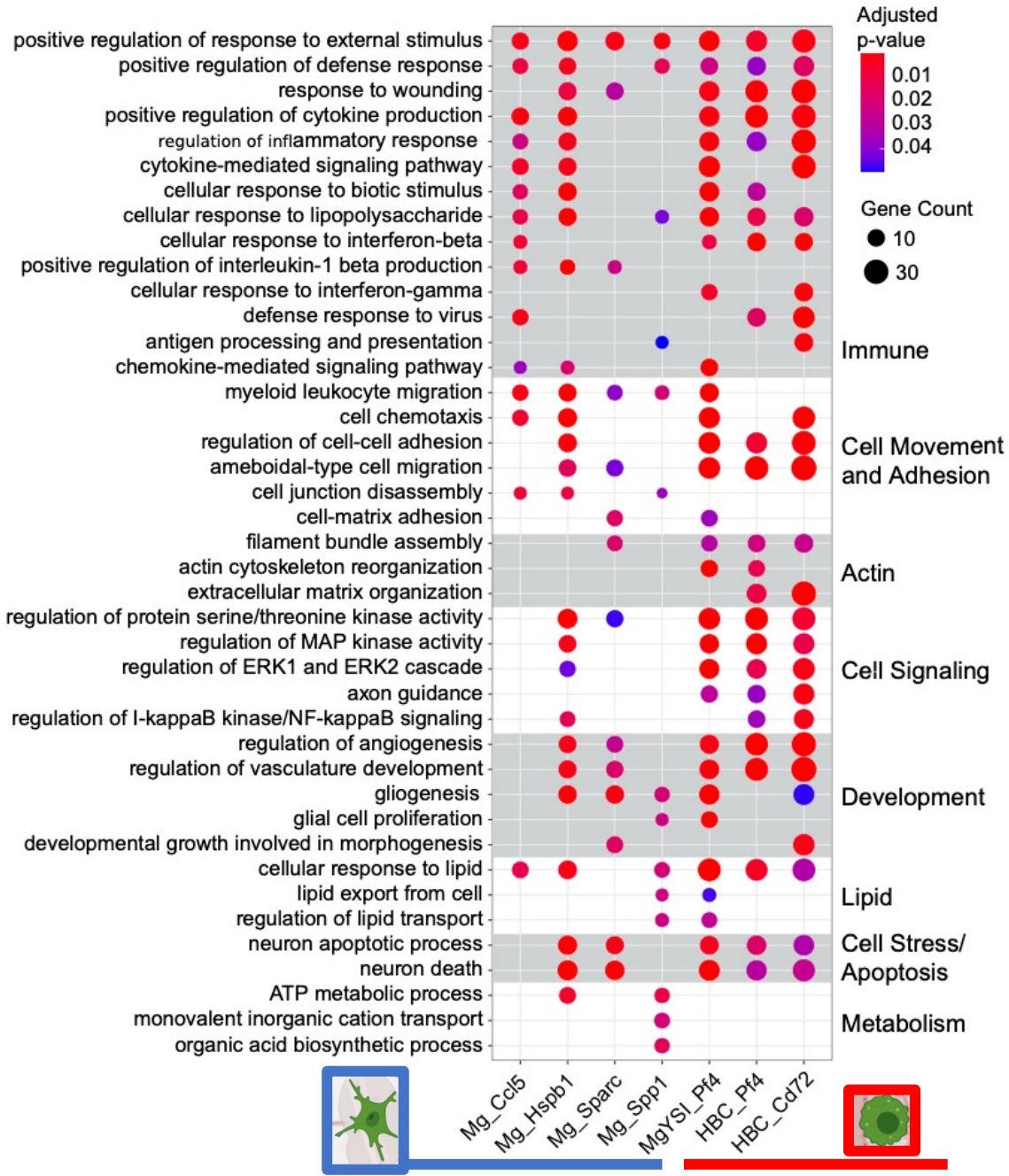
Fraction of genes in the database with the Annotation

ID	Description	GeneRatio	BgRatio	pvalue	p.adjust	geneID
GO:0007059	chromosome segregation	53/467	309/16976	3.60E-27	1.36E-23	Birc5/Ube2c/ Top2a/Mki67/ …
GO:0000070	mitotic sister chromatid segregation	34/467	147/16976	4.02E-22	7.61E-19	Birc5/Ube2c/ Cdca8/Nusap 1/…

…

Next, visualize many 100's of results

GO Enrichment for Macrophage subset Marker Genes



We find mostly overlapping functions for Brain Microglia and Placental Hofbauer cells

Do these cells respond similarly to Maternal Obesity?