Report

Population Version

The data consists of 1068 simulations from networks from the `bnlearn` repository. In order to determine conditional independence for the population version, we consider d-separation from the true DAG. For the estimation of the skeleton, the maximum number of nodes we consider in a separating set is 3 (our default). For each network, we consider target sets T with $|T| \in \{1, 2, 3, 4, 5\}$. Below is a table of some of the results

Same V-Structures

Comparing only the nodes in the neighborhood, we found that in all 930 cases, the population PC correctly identified all the V-structures

SHD

Also, for all 930 cases, we found that the SHD was 0 in every case.

False Negatives and False Positives

Since we do not implement all of Meek's rules in the local setting, we can view some other statistics concerning false negatives and false positives. Each number in the table below is the number of times that number of false positives/false negatives are observed for a particular network and set of target nodes. These statistics come from comparisons between the estimated CPDAG and the true CPDAG.

False Negatives

```
##
##   0   1   2   3   4   5   6   7   8  10  12  14  20
## 675 155 121  30  30  24  13   7   6   2   3   1   1
```

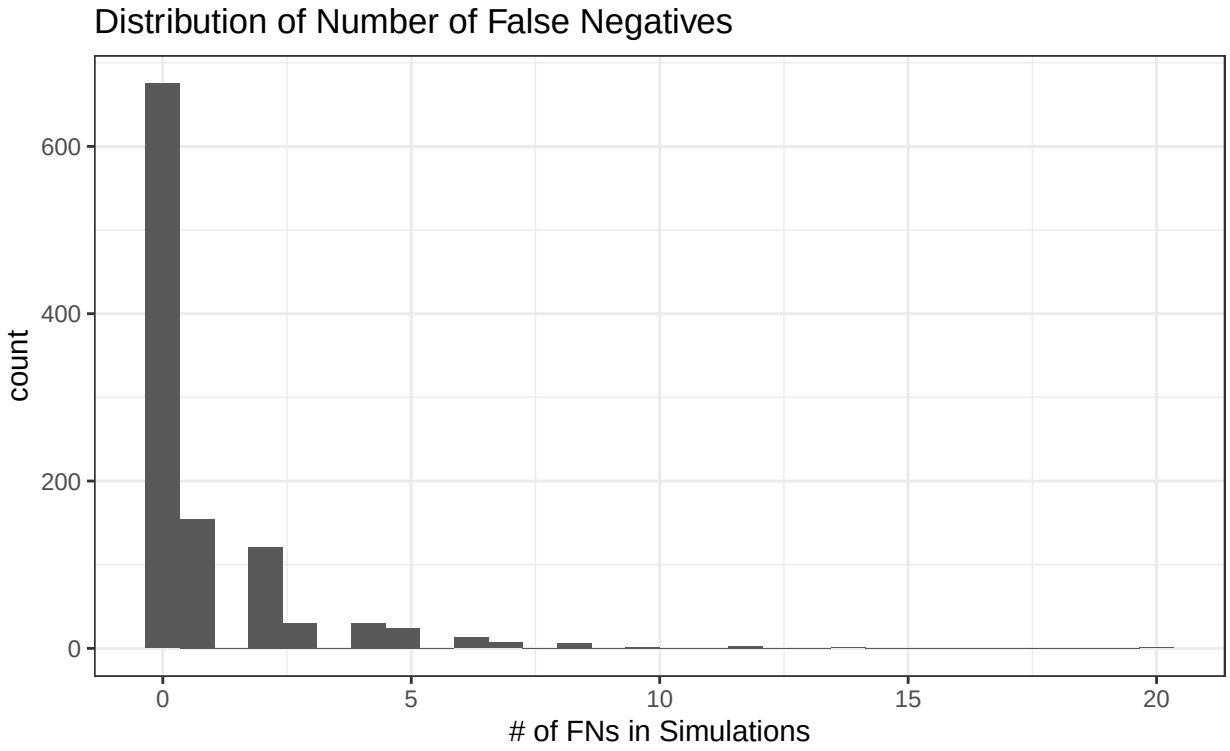
False Positives

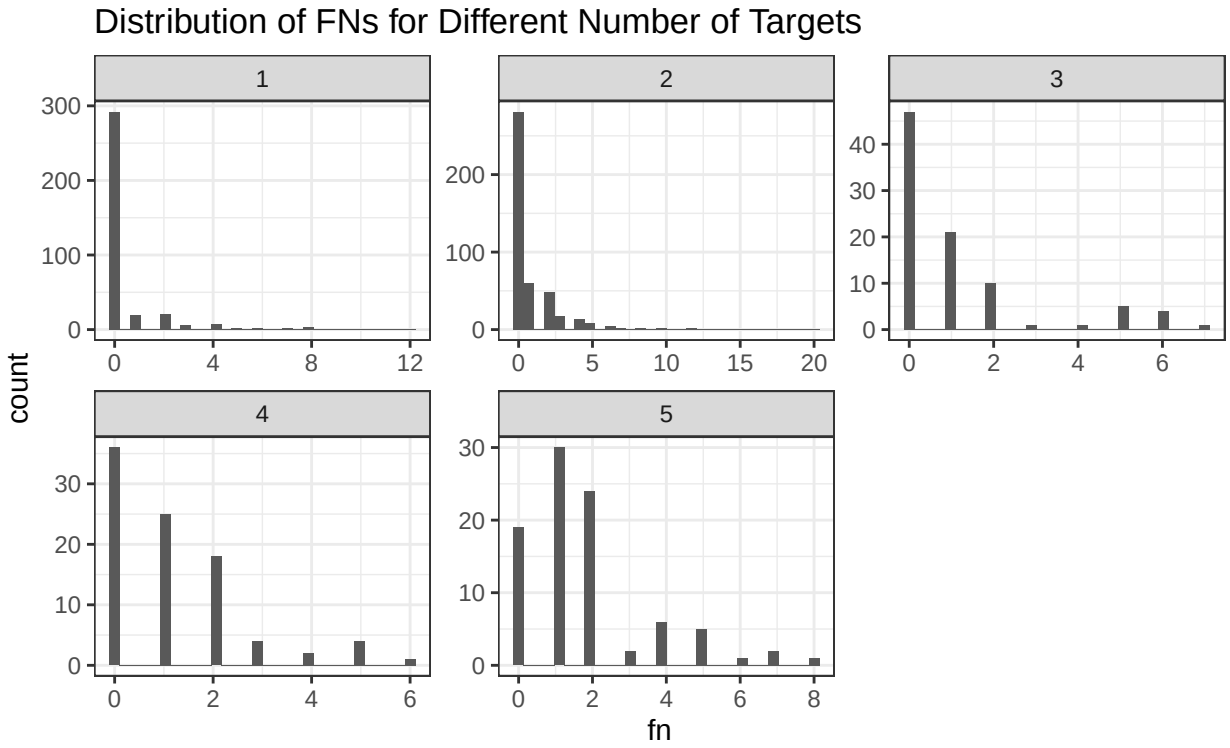
```
##
##   0   1   2   3   4   5   6   7   8   9  10  11  12  14  15  17  20  21
## 650 151 124  25  30  24  19  13   3   1   3   2   2   1   1   1   6   1
##  22  28  29  33  34  35  40
##   1   2   1   2   2   2   1
```

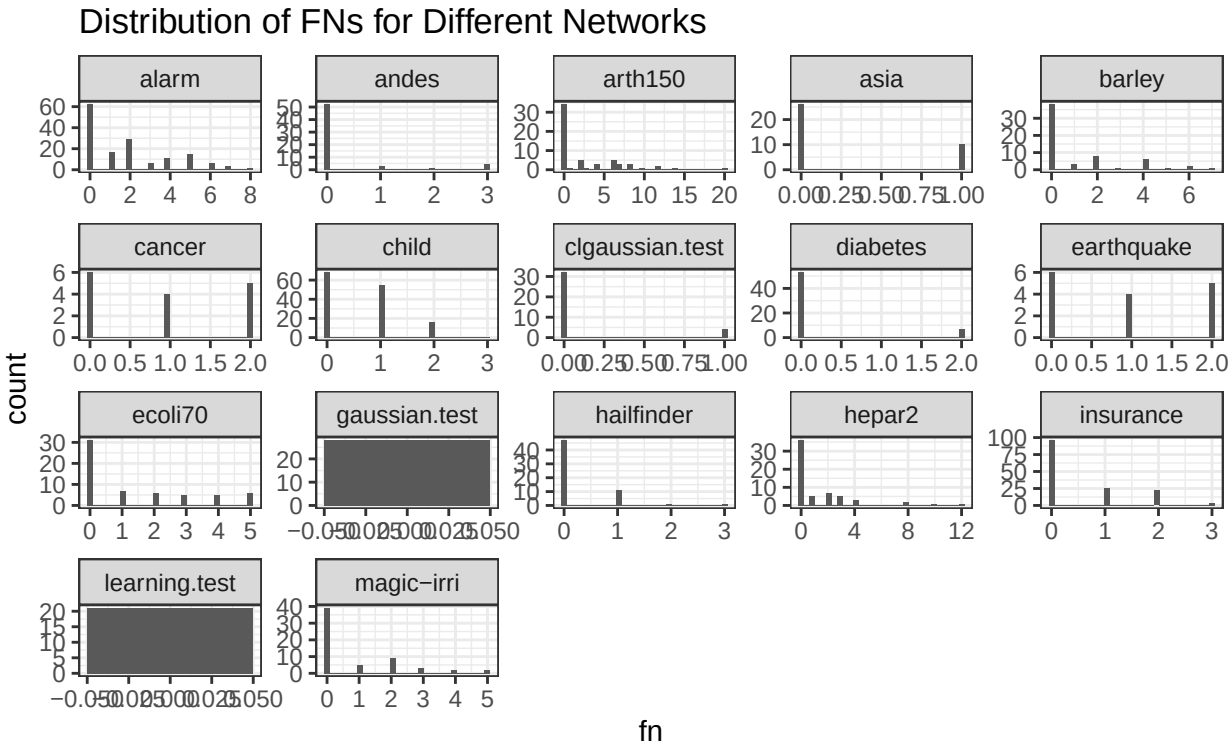
These tables are equivalent because each false negative and false positive represents an undirected edge in the estimated CPDAG that is directed in the true CPDAG.

Visualizations

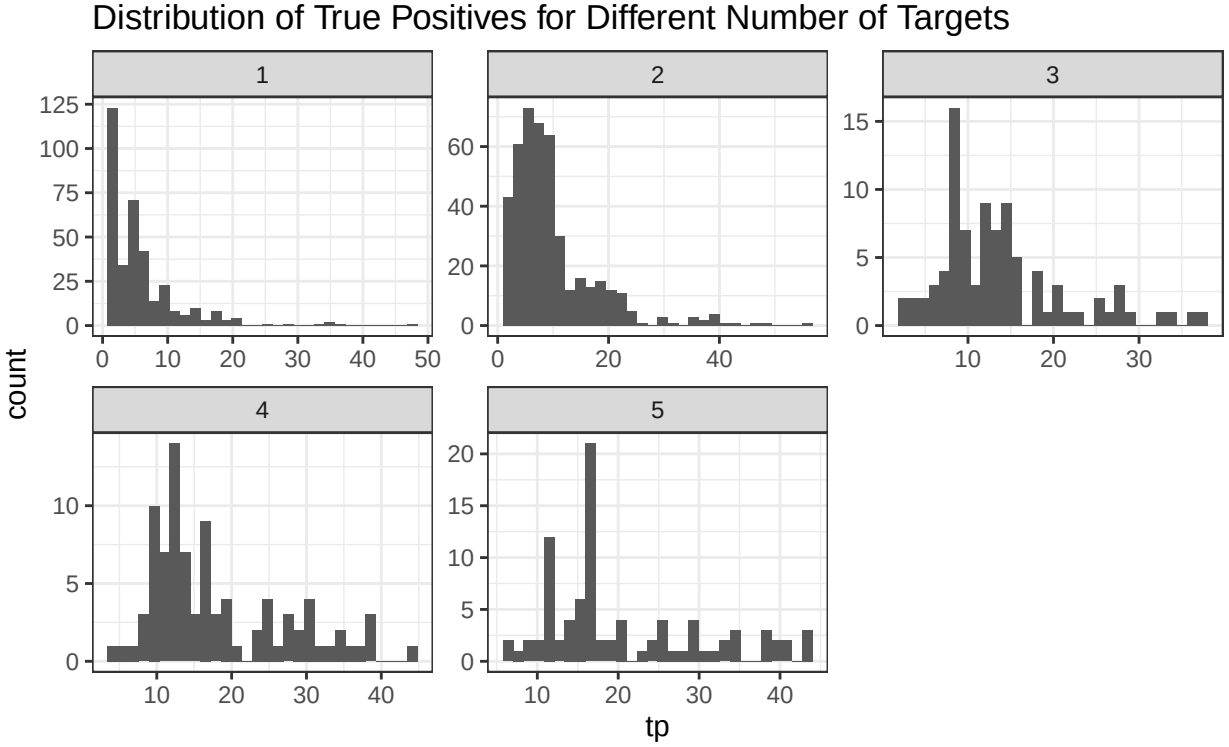
False Negatives

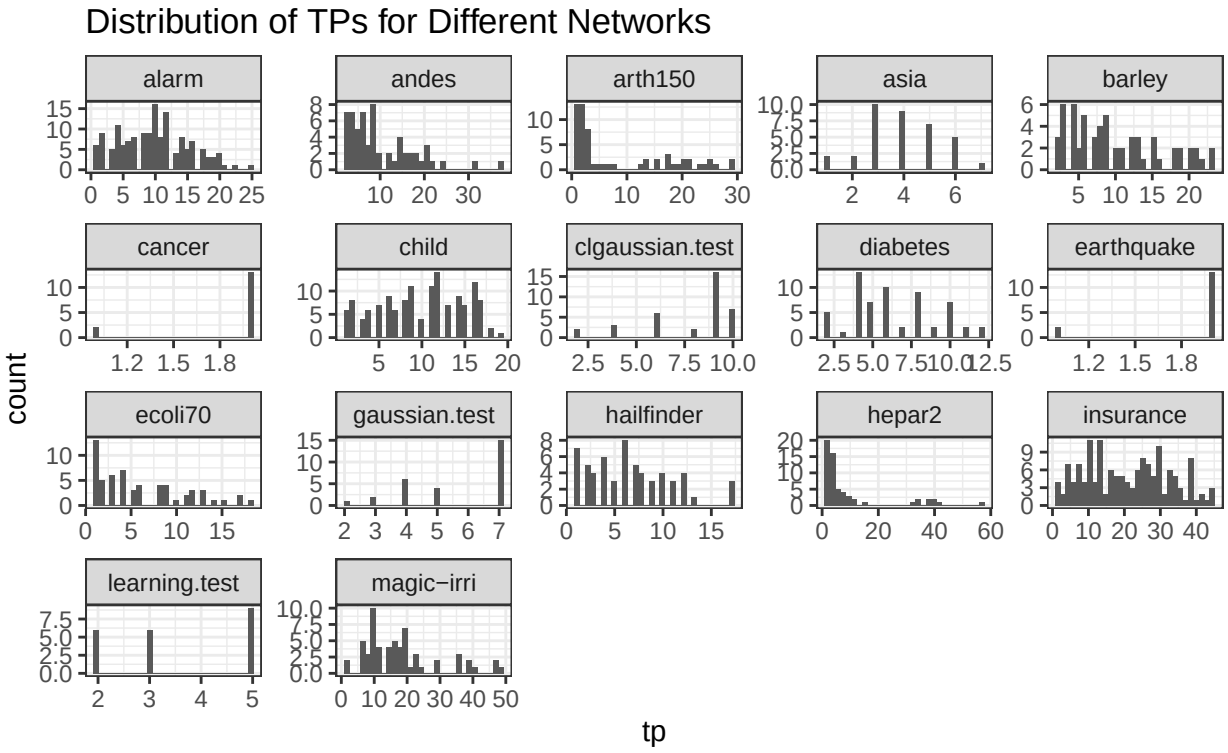

Distribution of Number of False Negatives
count
600
400
200
0
0
5
10
15
20
# of FNs in Simulations


Distribution of FNs for Different Number of Targets
1
2
3
4
5
count
fn



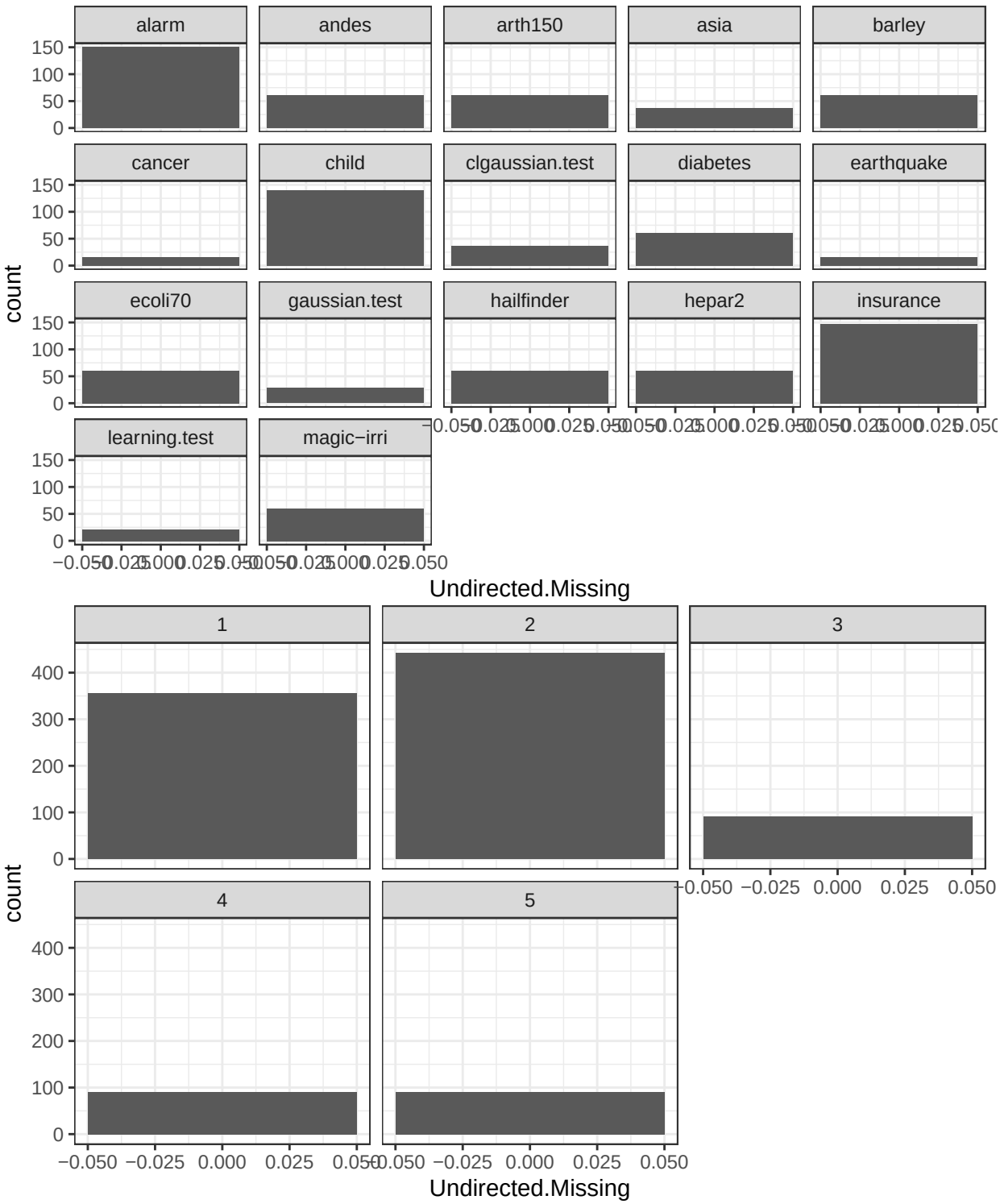
True Positives

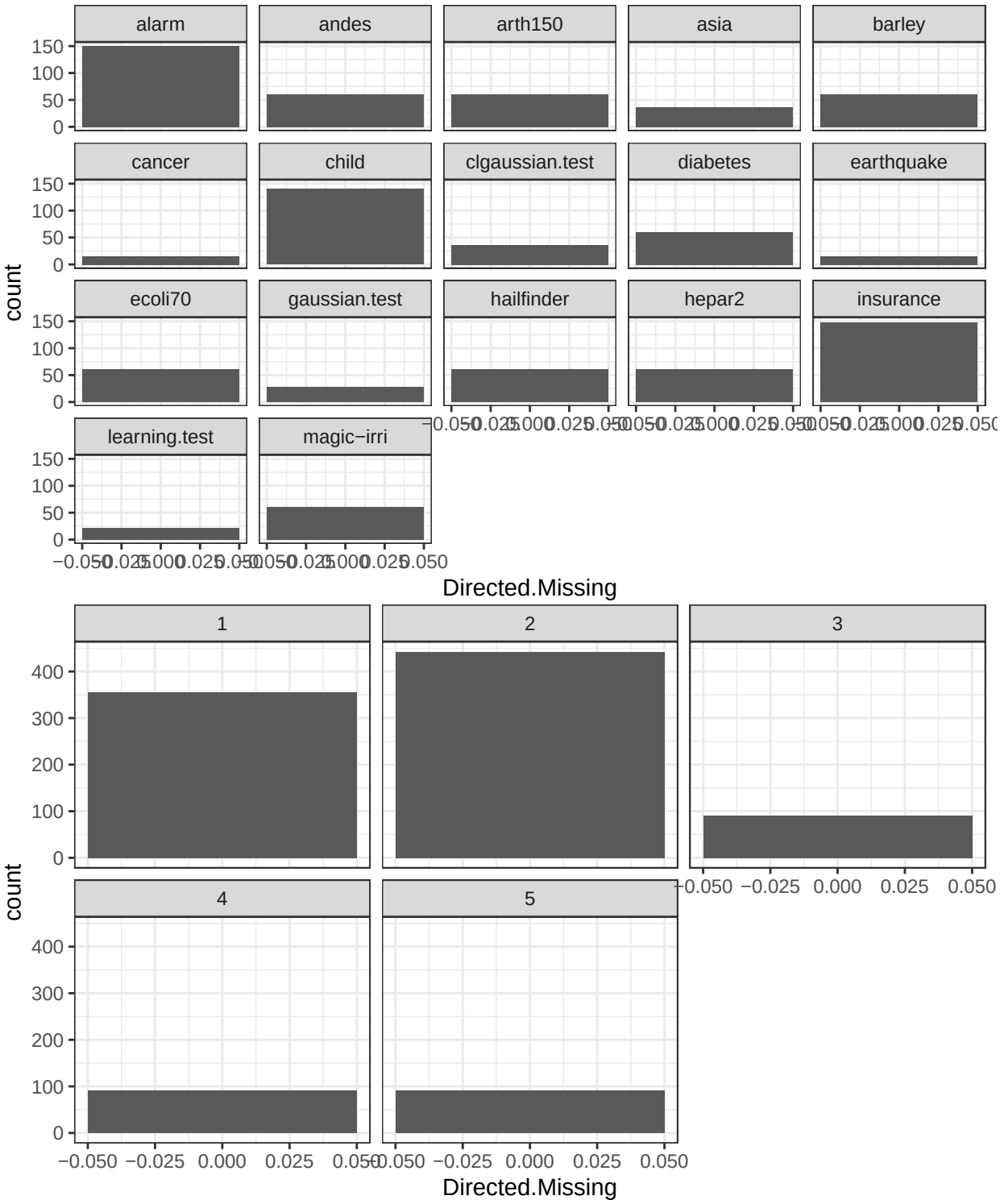


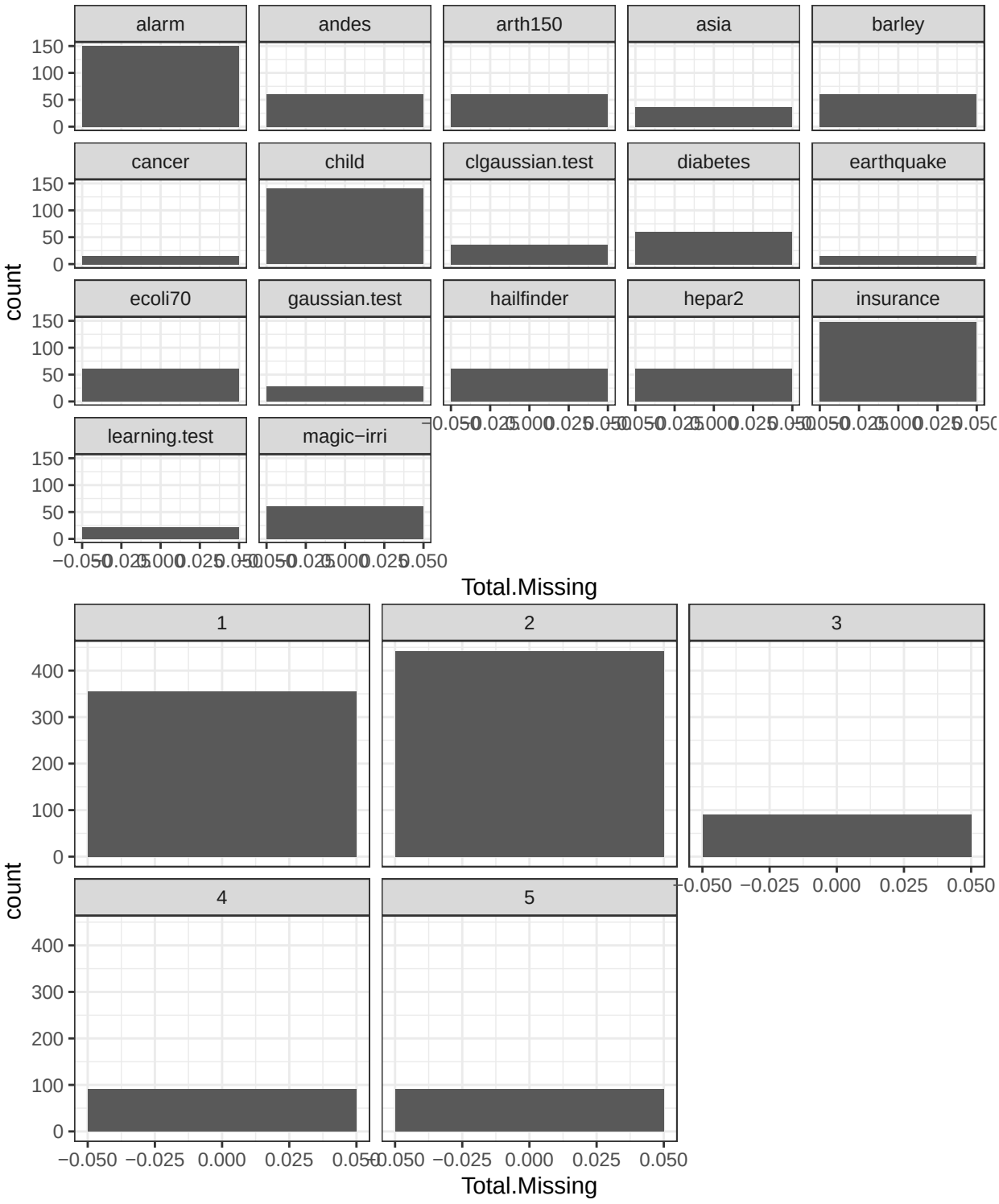

Distribution of TPs for Different Networks
alarm
andes
arth150
asia
barley
cancer
child
clgaussian.test
diabetes
earthquake
ecoli70
gaussian.test
hailfinder
hepar2
insurance
learning.test
magic−irri
count
tp

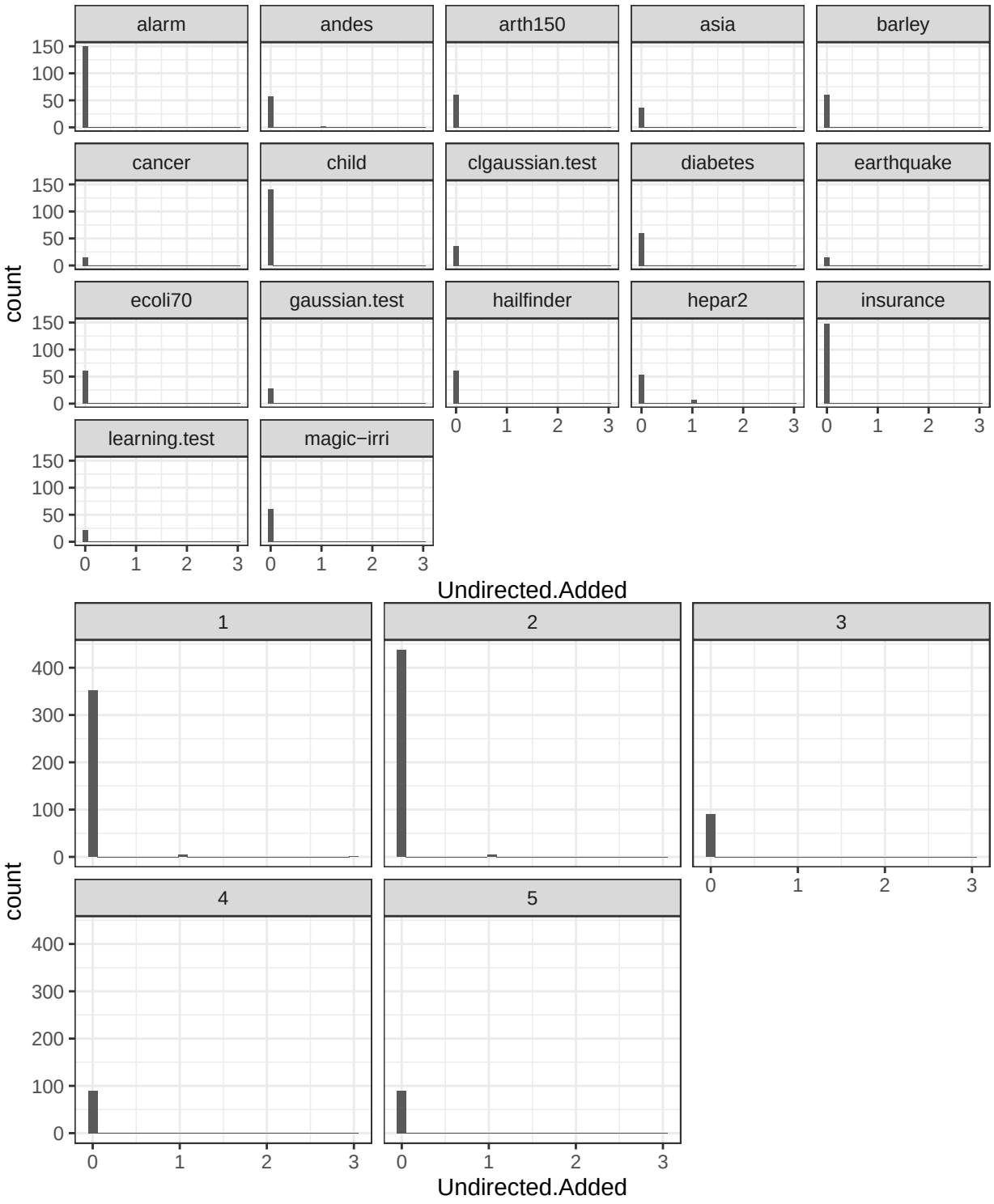
Distribution of Other Statistics

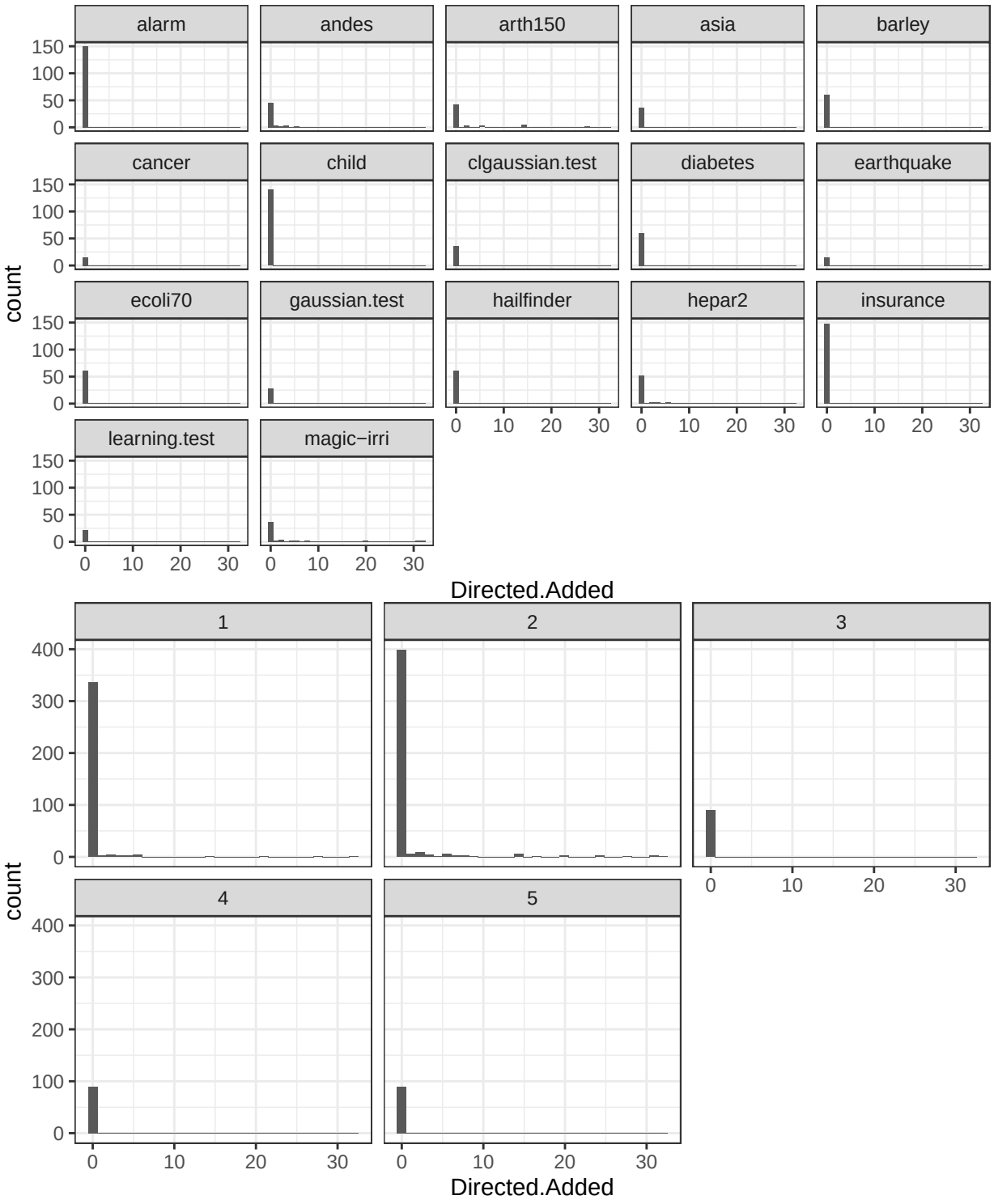
Undirected Edges Missing in Estimated CPDAG

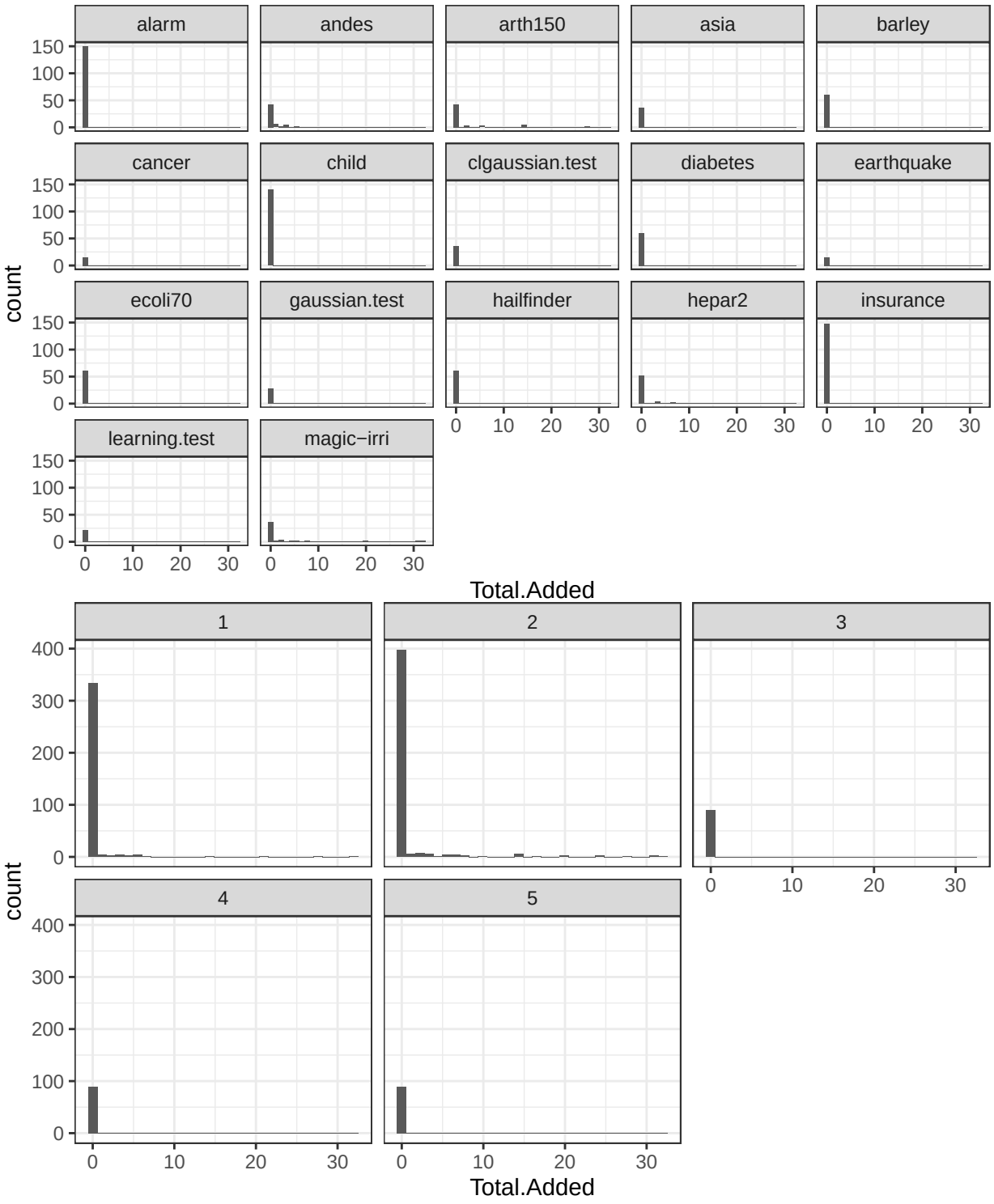


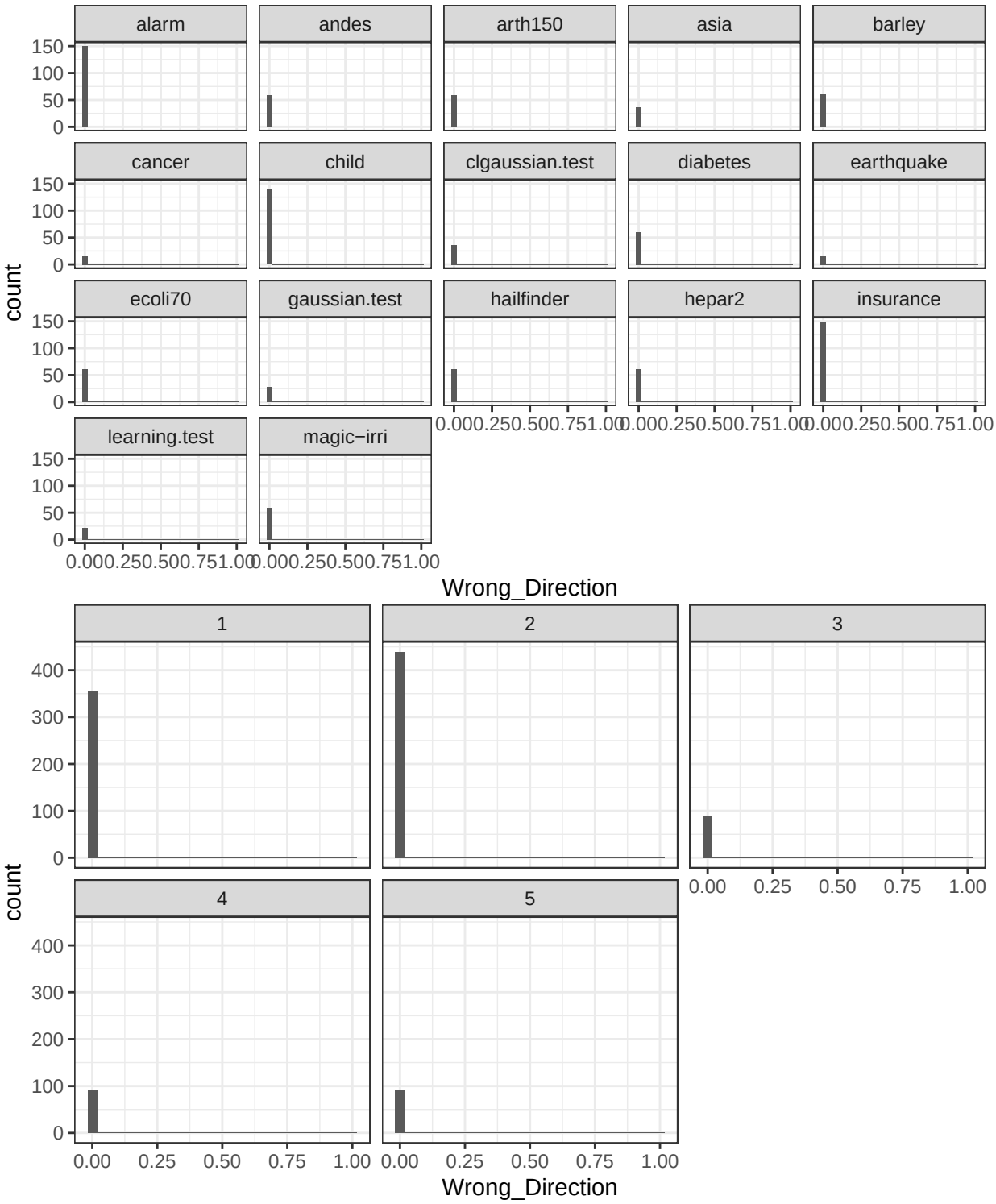

alarm
andes
arth150
asia
barley
cancer
child
clgaussian.test
diabetes
earthquake
ecoli70
gaussian.test
hailfinder
hepar2
insurance
learning.test
magic−irri
count
Directed.Missing
1
2
3
4
5
count
Directed.Missing

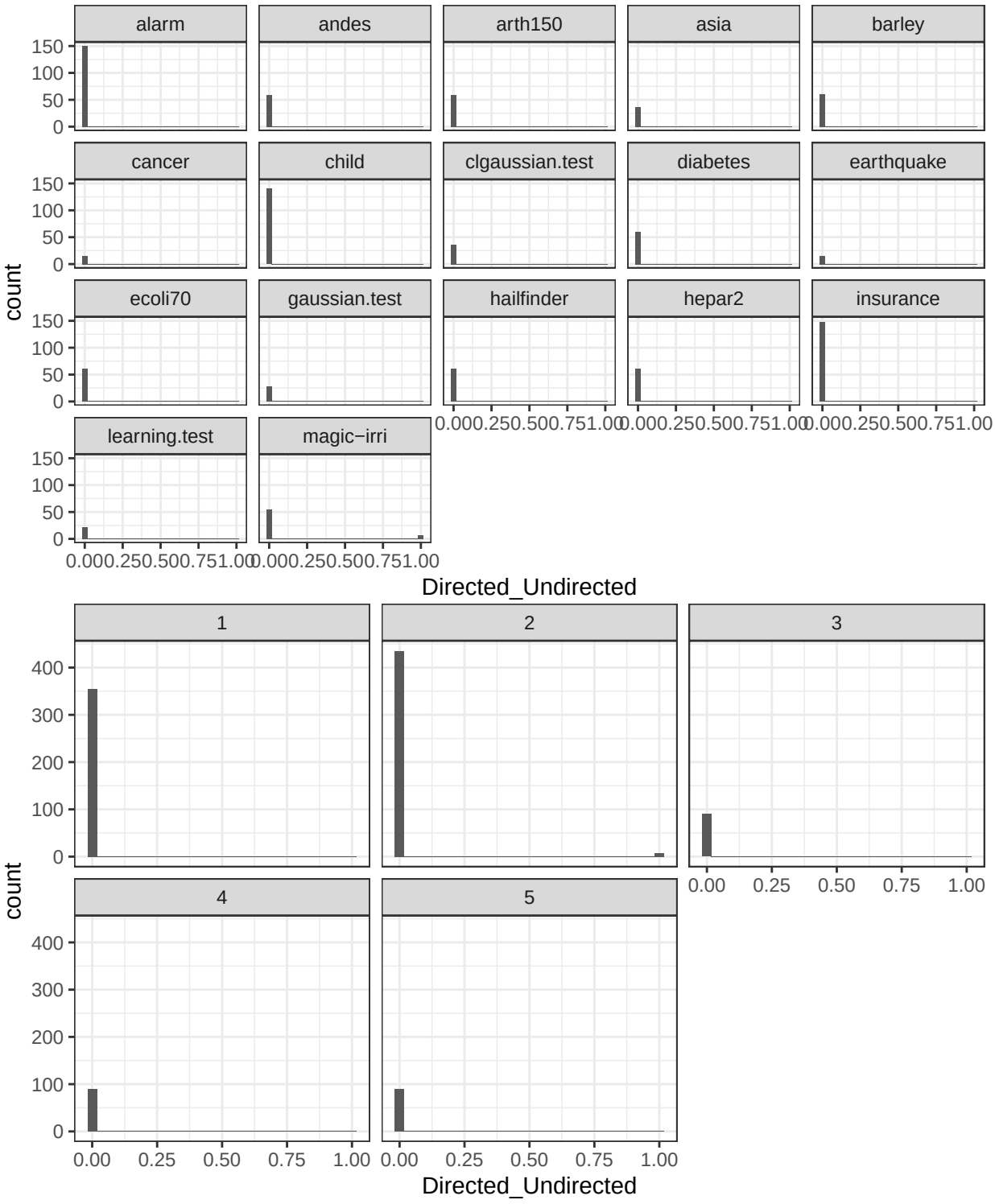

alarm
andes
arth150
asia
barley
cancer
child
clgaussian.test
diabetes
earthquake
ecoli70
gaussian.test
hailfinder
hepar2
insurance
learning.test
magic−irri
count
Total.Missing
1
2
3
4
5
count
Total.Missing

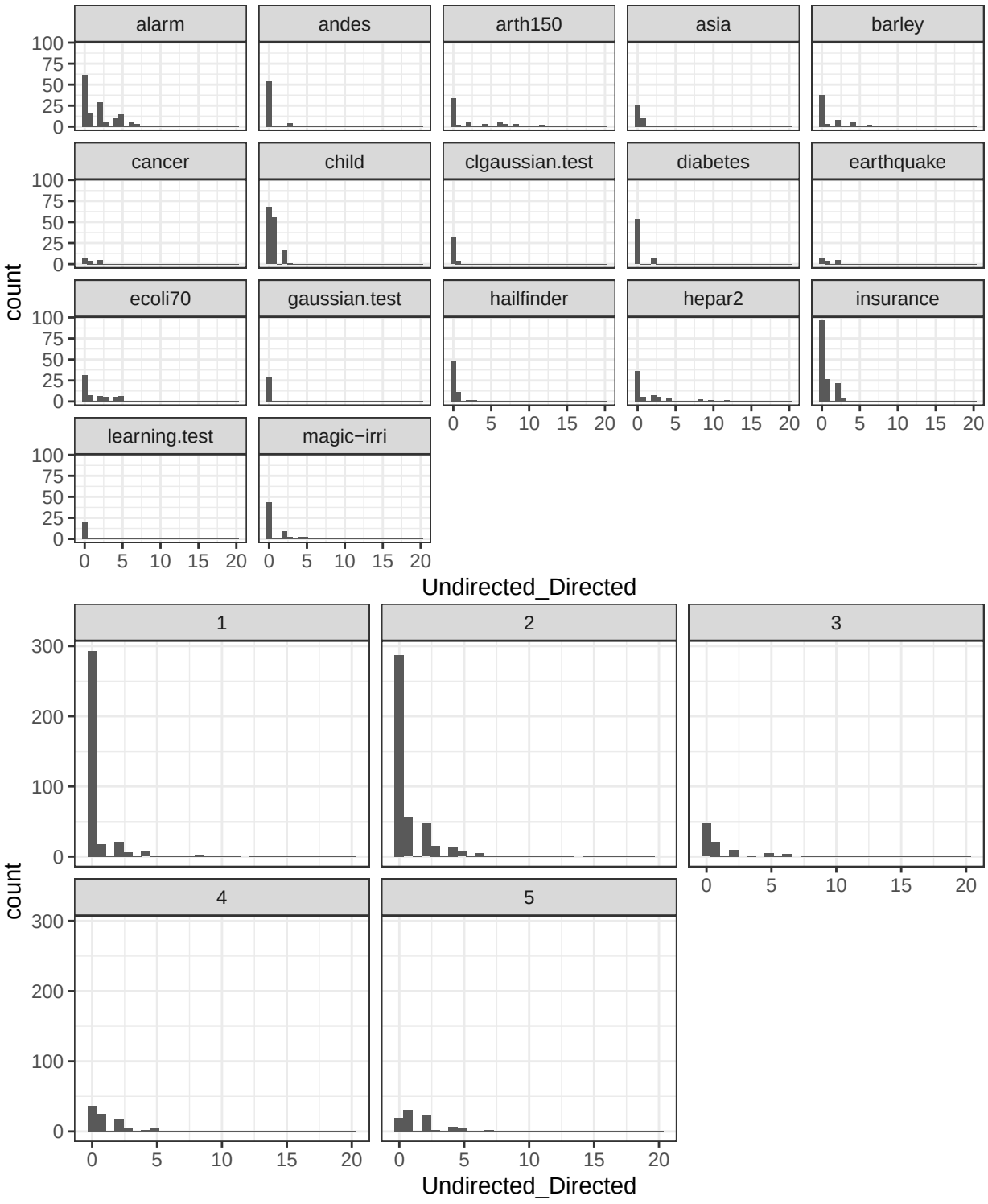

alarm
andes
arth150
asia
barley
cancer
child
clgaussian.test
diabetes
earthquake
ecoli70
gaussian.test
hailfinder
hepar2
insurance
learning.test
magic−irri
count
Undirected.Added
1
2
3
4
5
count
Undirected.Added


alarm
andes
arth150
asia
barley
cancer
child
clgaussian.test
diabetes
earthquake
ecoli70
gaussian.test
hailfinder
hepar2
insurance
learning.test
magic−irri
count
Directed.Added
1
2
3
4
5
count
Directed.Added


alarm
andes
arth150
asia
barley
cancer
child
clgaussian.test
diabetes
earthquake
ecoli70
gaussian.test
hailfinder
hepar2
insurance
learning.test
magic−irri
count
Total.Added
1
2
3
4
5
count
Total.Added


alarm
andes
arth150
asia
barley
cancer
child
clgaussian.test
diabetes
earthquake
ecoli70
gaussian.test
hailfinder
hepar2
insurance
learning.test
magic−irri
count
Wrong_Direction
1
2
3
4
5
count
Wrong_Direction


alarm
andes
arth150
asia
barley
cancer
child
clgaussian.test
diabetes
earthquake
ecoli70
gaussian.test
hailfinder
hepar2
insurance
learning.test
magic−irri
count
Directed_Undirected
1
2
3
4
5
count
Directed_Undirected



Sample Version

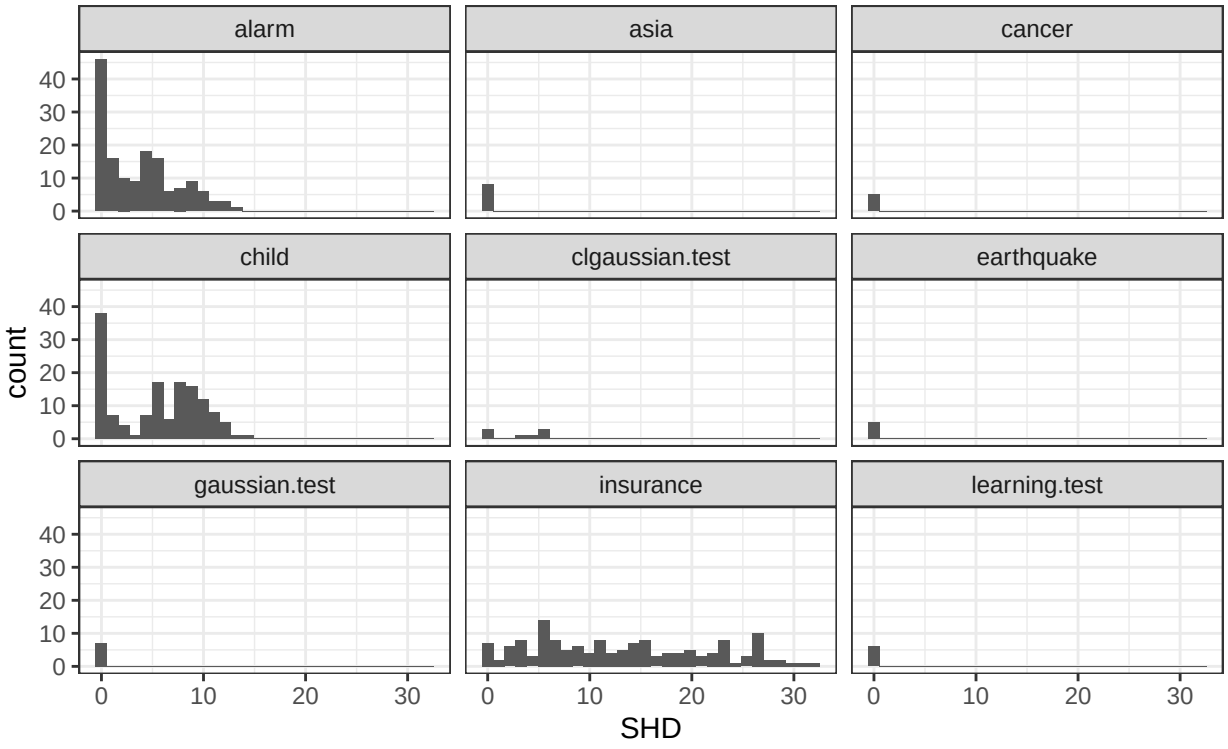
This is a preliminary display of the results. We are using a significance level of 0.05 for our hypothesis tests.

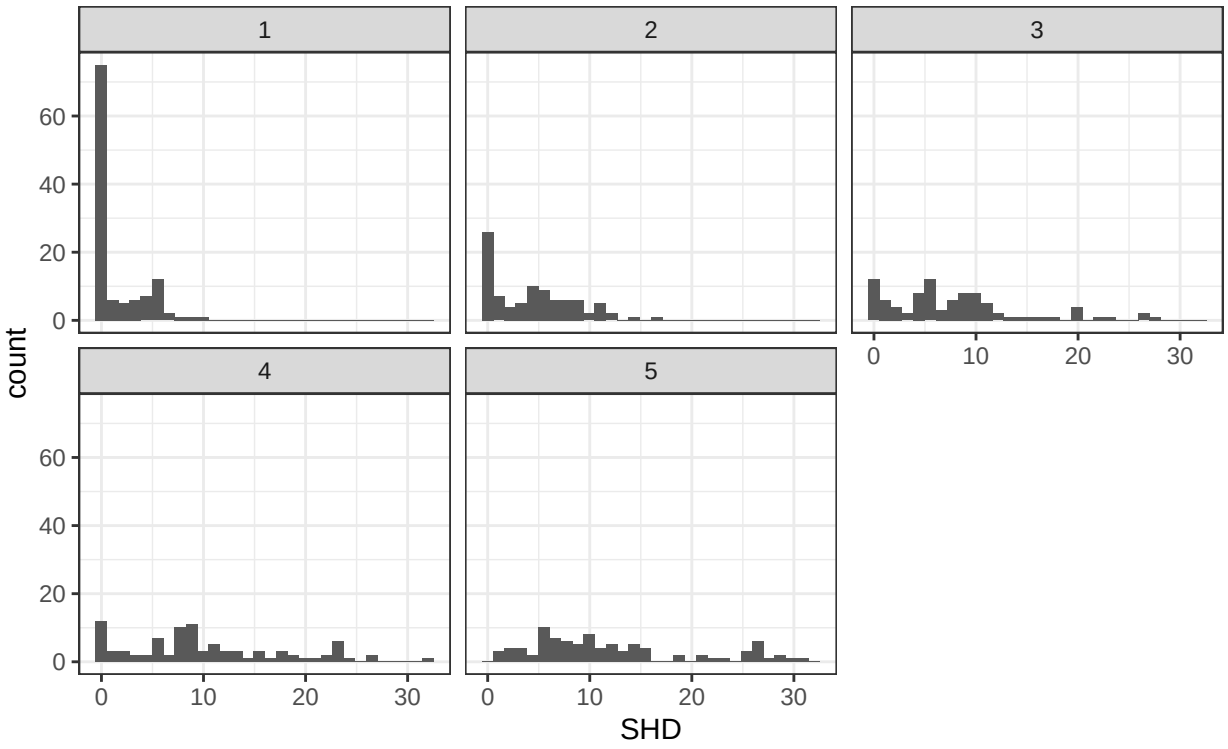
Same V-Structures

```
##
##   0   1
## 335 141
```

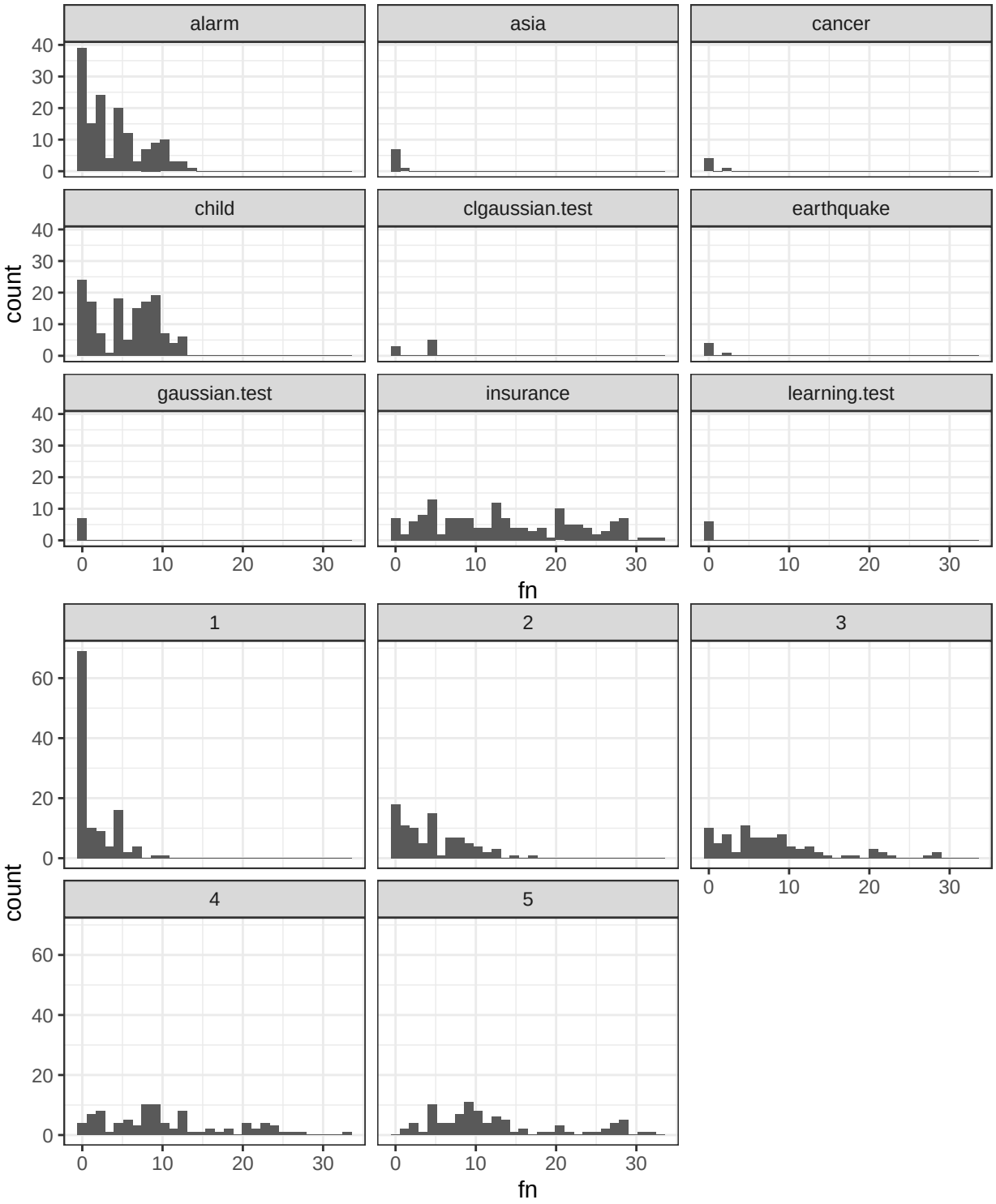
SHD

```
##
##   0   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17
## 125  25  20  19  29  29  21  20  29  31  22  19  12   7   8   4   4   3
##  18  19  20  21  22  23  24  25  26  27  28  29  30  31  32
##   4   4   5   3   4   8   1   3   4   6   2   2   1   1   1
```

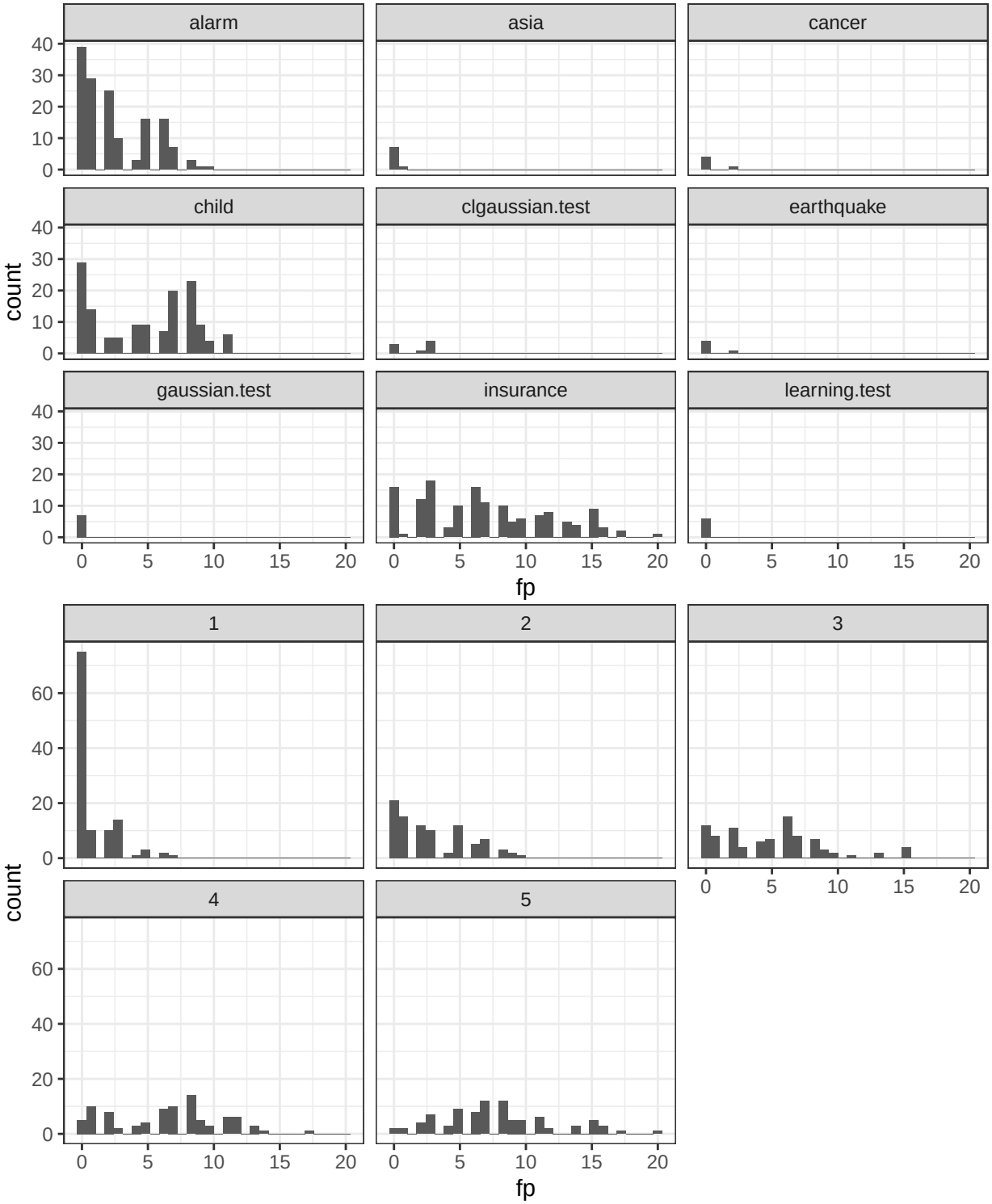



1
2
3
4
5
count
SHD
0
20
40
60
0
10
20
30

False Negatives

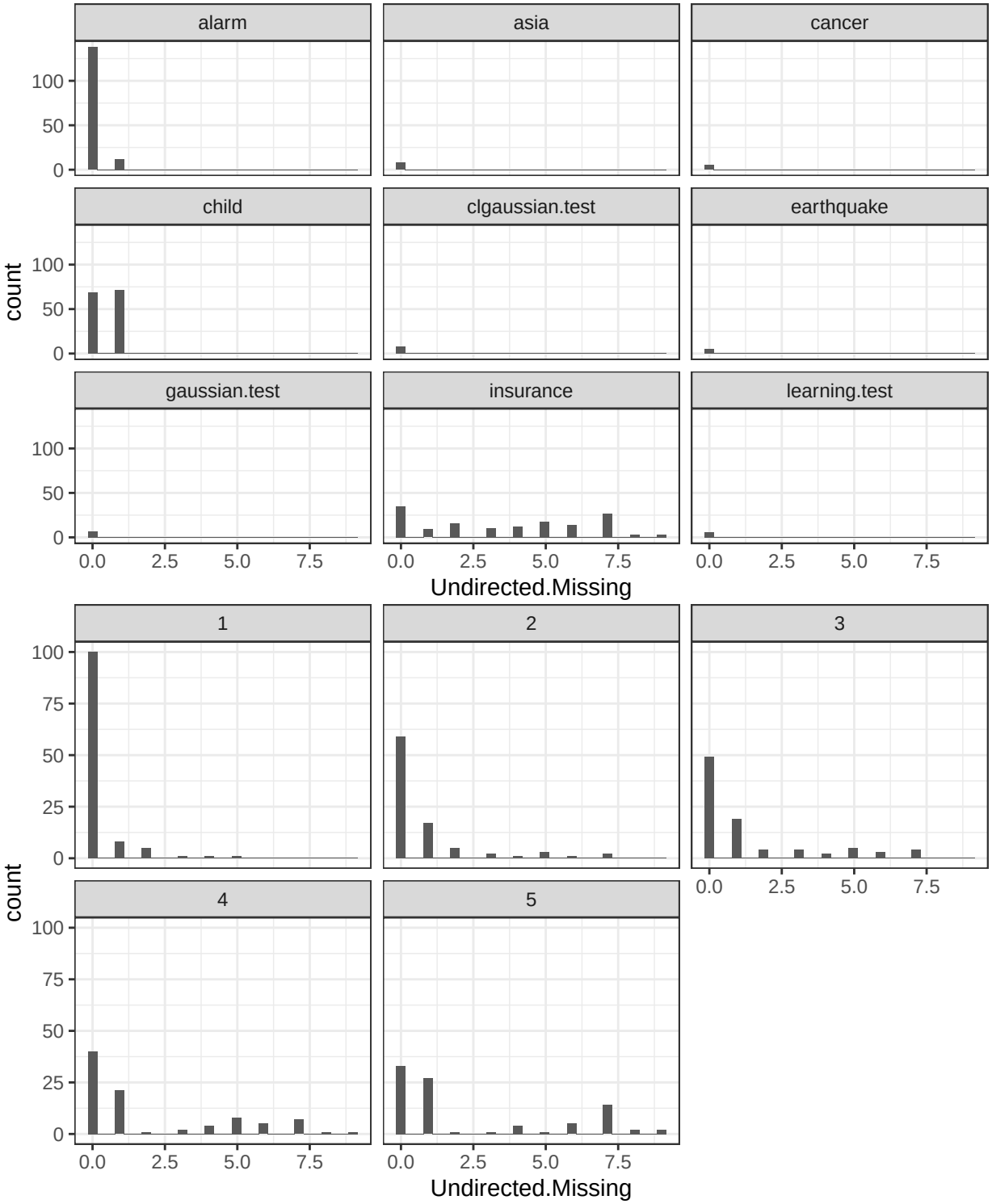


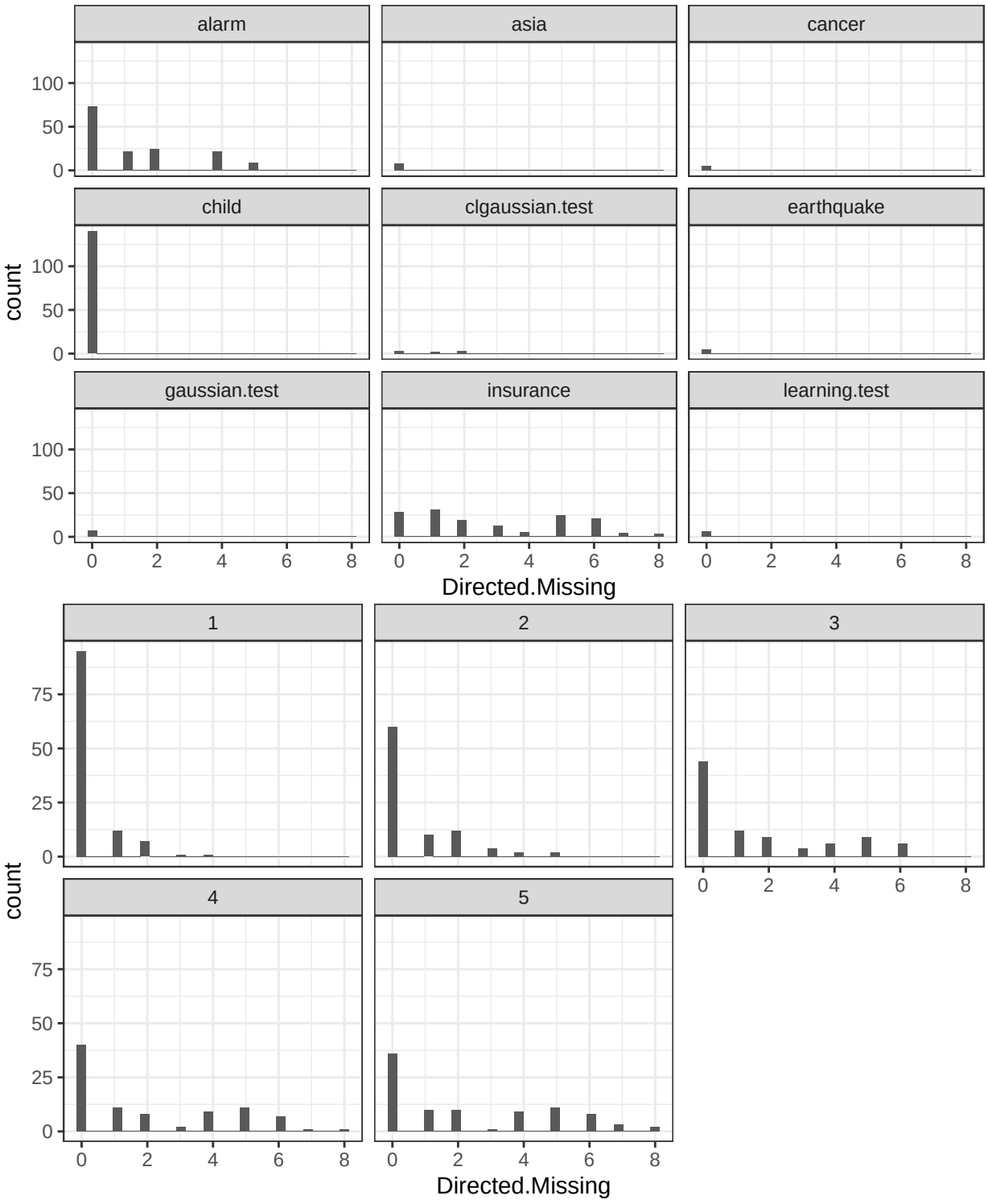
False Positives

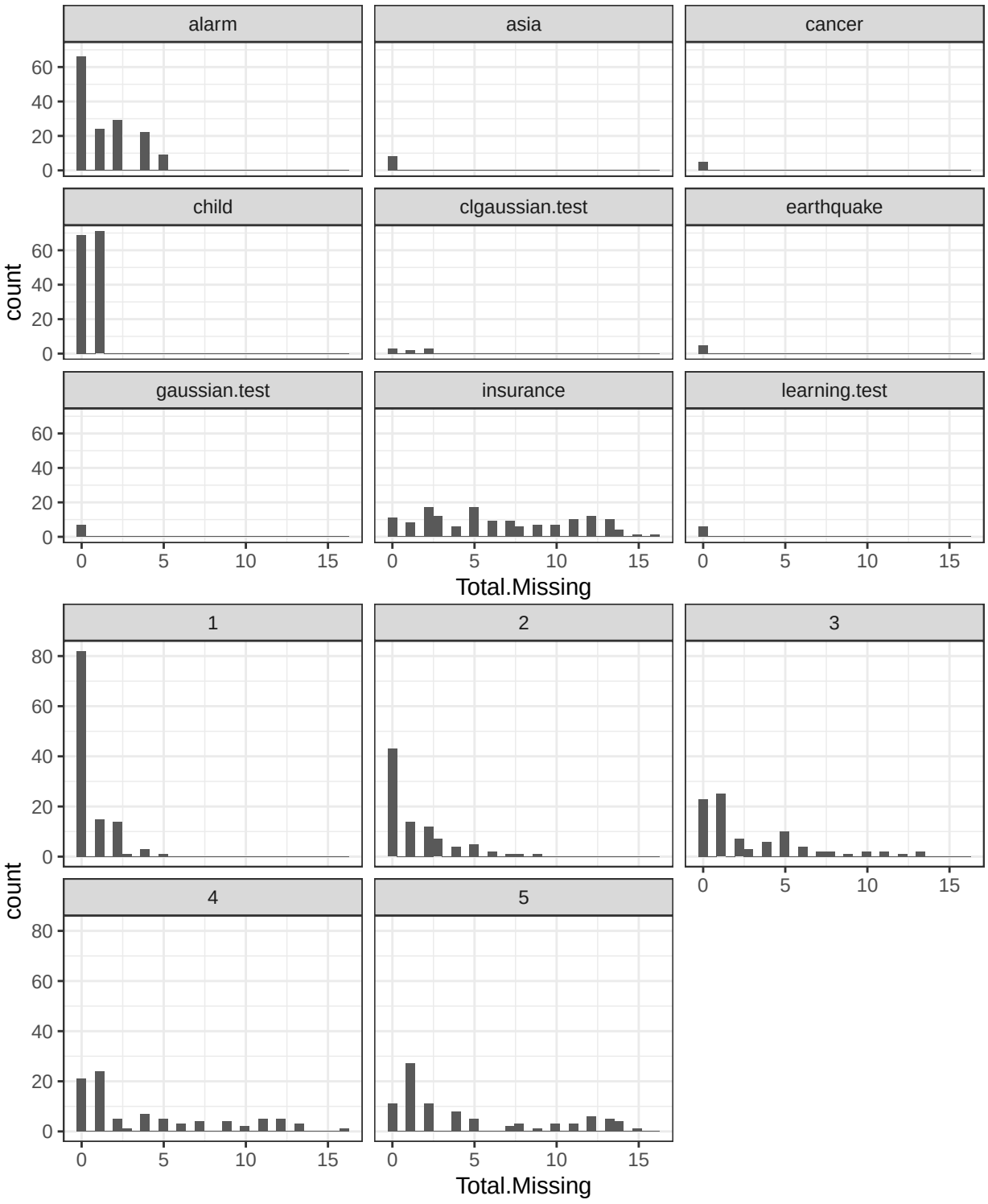


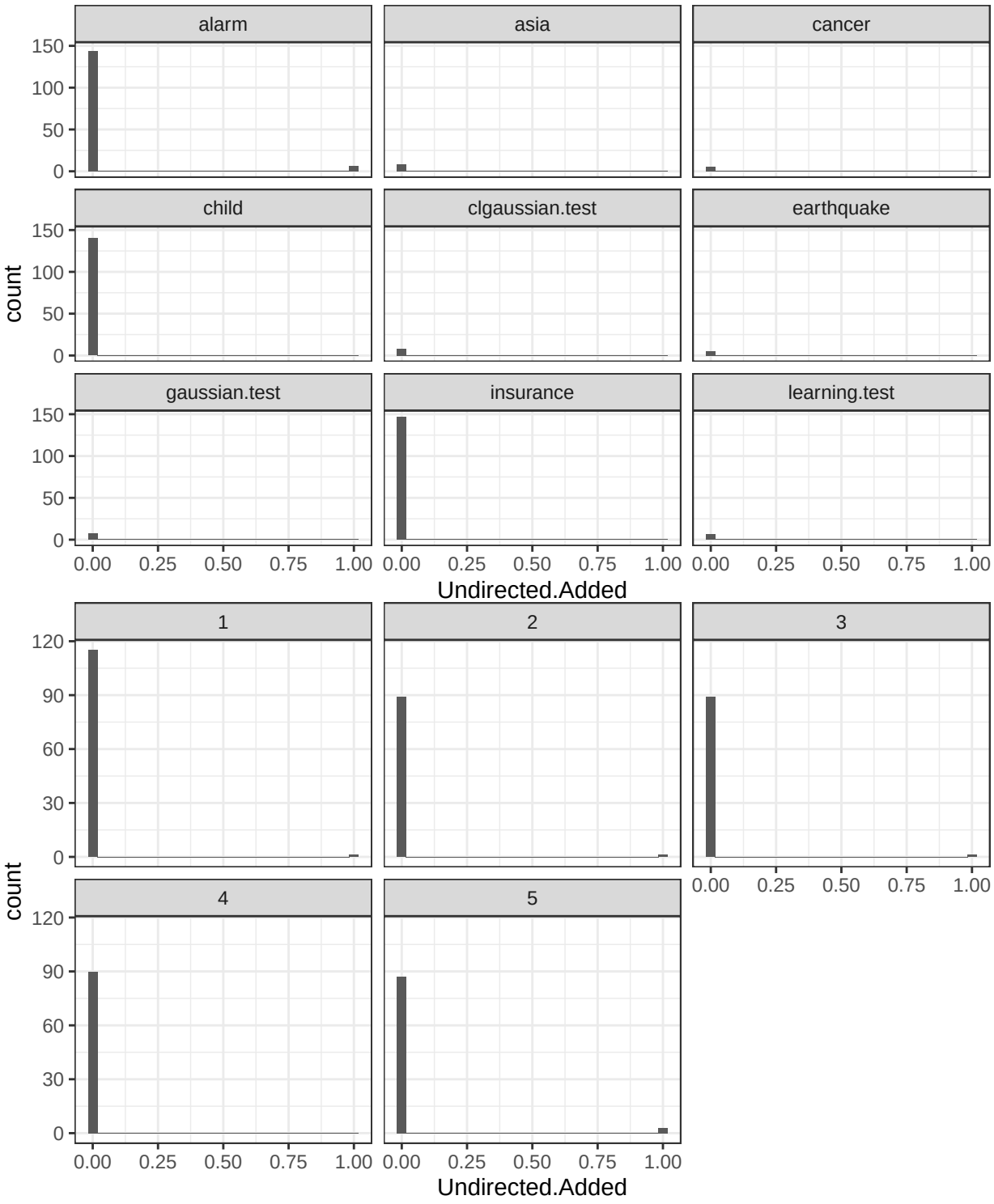
Distribution of Other Statistics

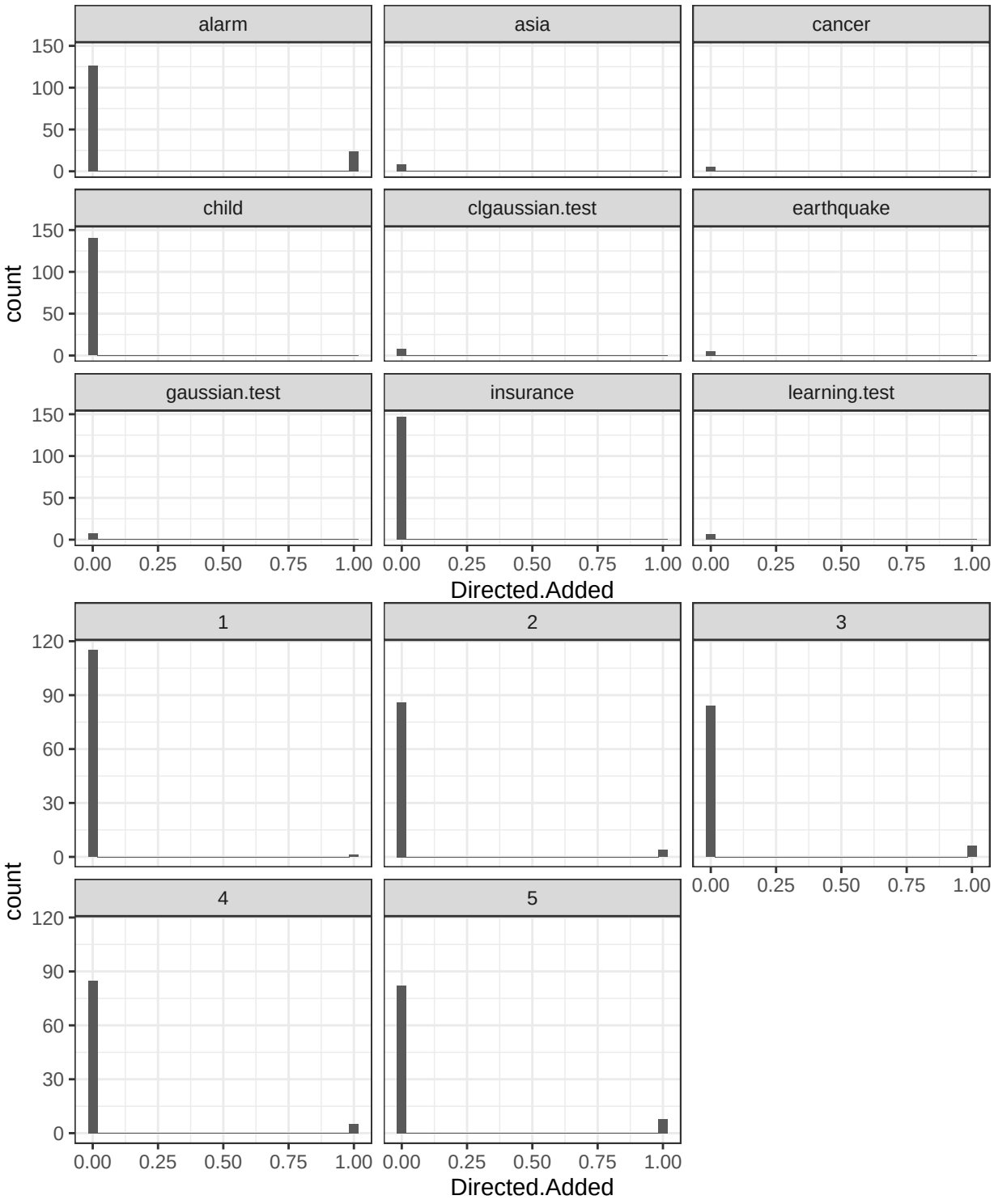
Undirected Edges Missing in Estimated CPDAG

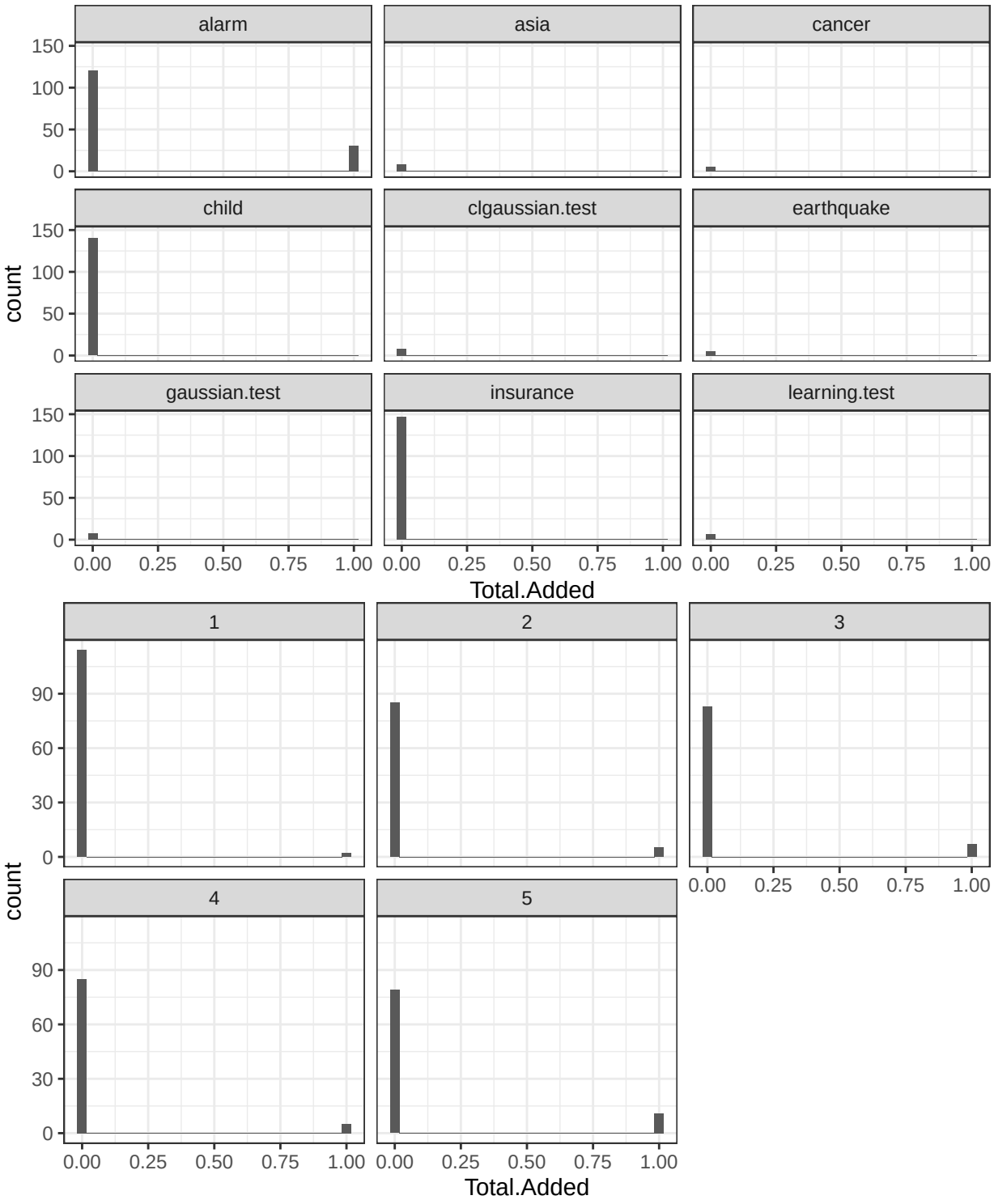


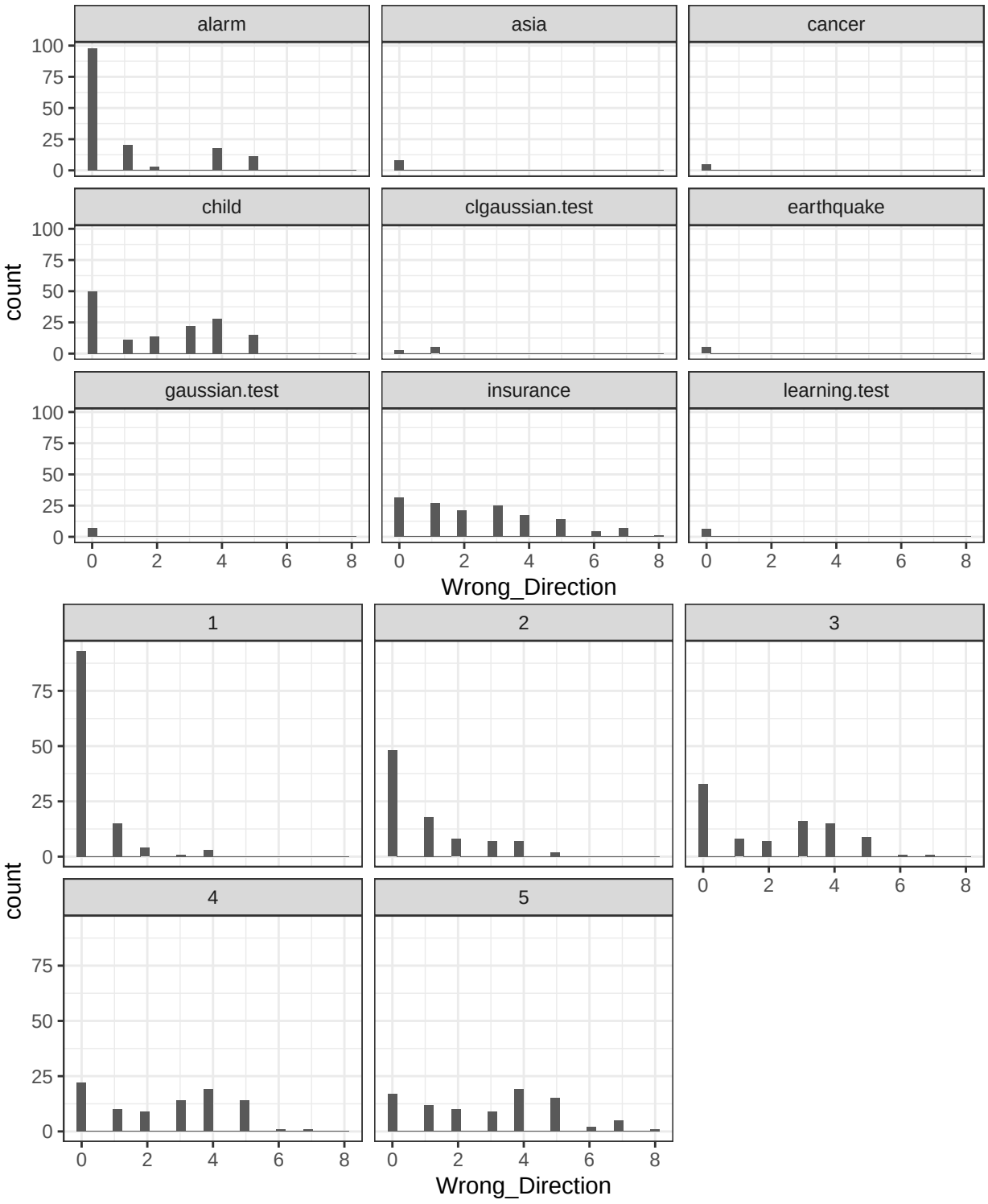

alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Directed.Missing
1
2
3
4
5
count
Directed.Missing

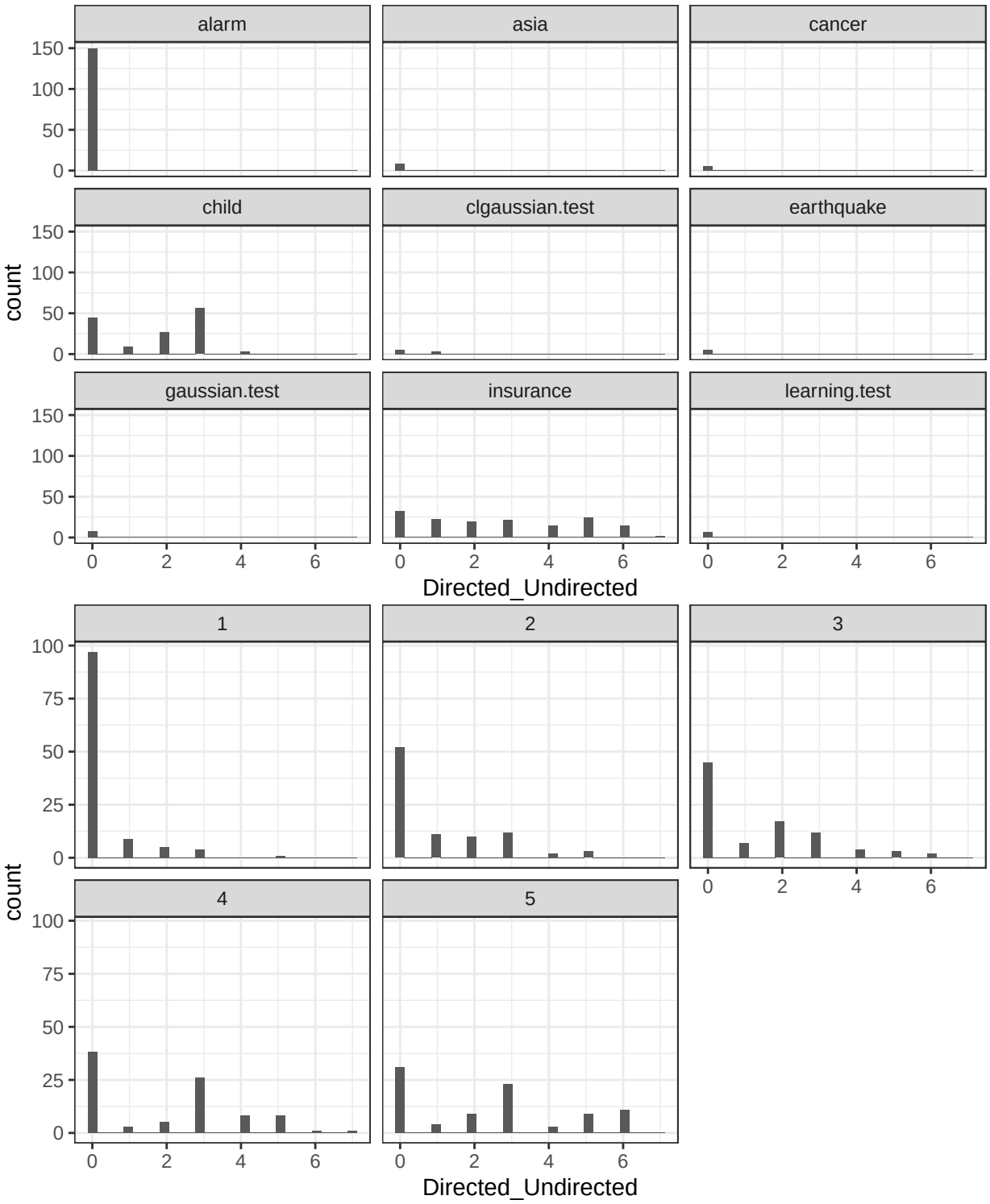

alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Total.Missing
1
2
3
4
5
count
Total.Missing

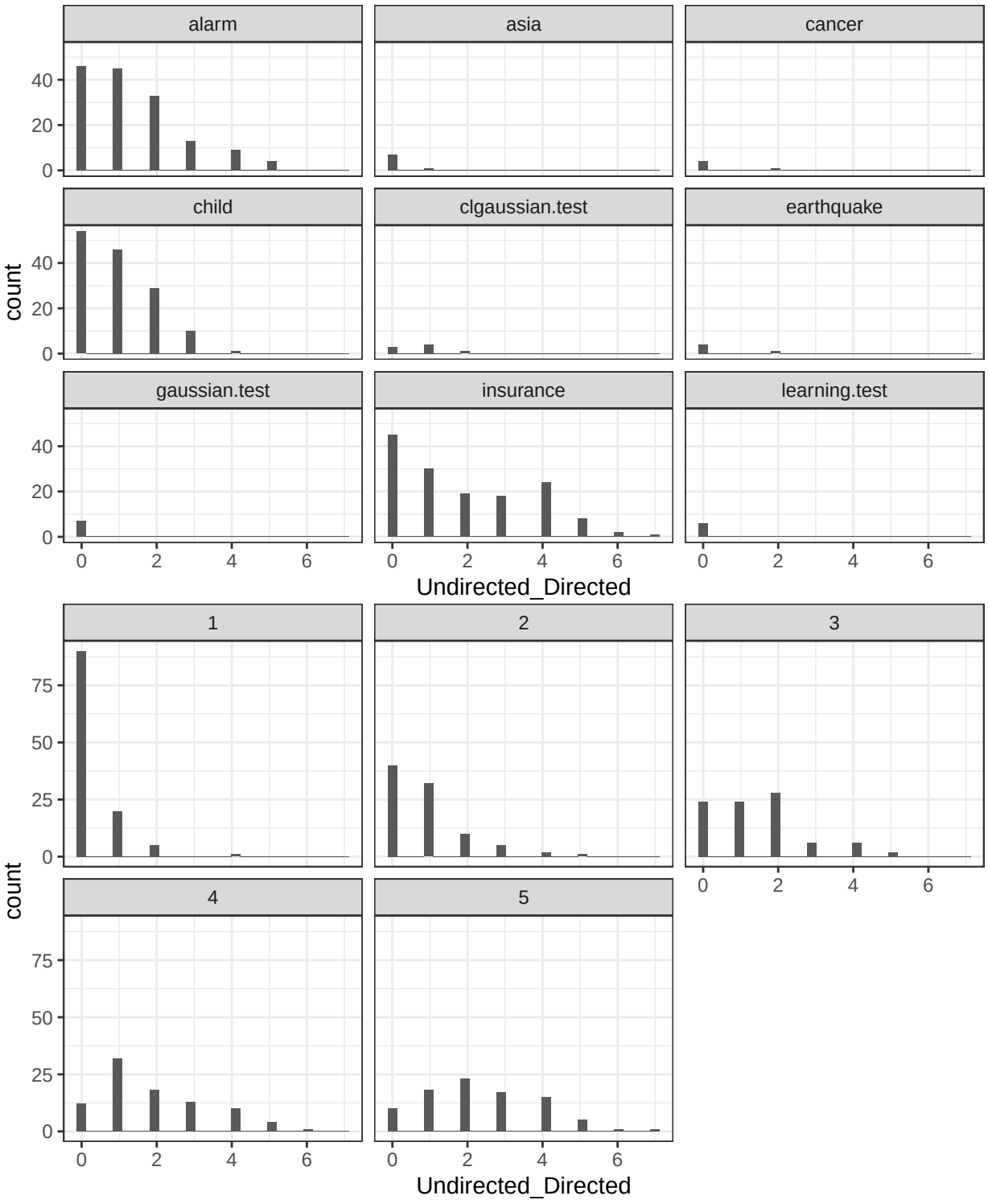

alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Undirected.Added
1
2
3
4
5
count
Undirected.Added


alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Directed.Added
1
2
3
4
5
count
Directed.Added


alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Total.Added
1
2
3
4
5
count
Total.Added


alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Wrong_Direction
1
2
3
4
5
count
Wrong_Direction


alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Directed_Undirected
1
2
3
4
5
count
Directed_Undirected



Sample Version Number 2

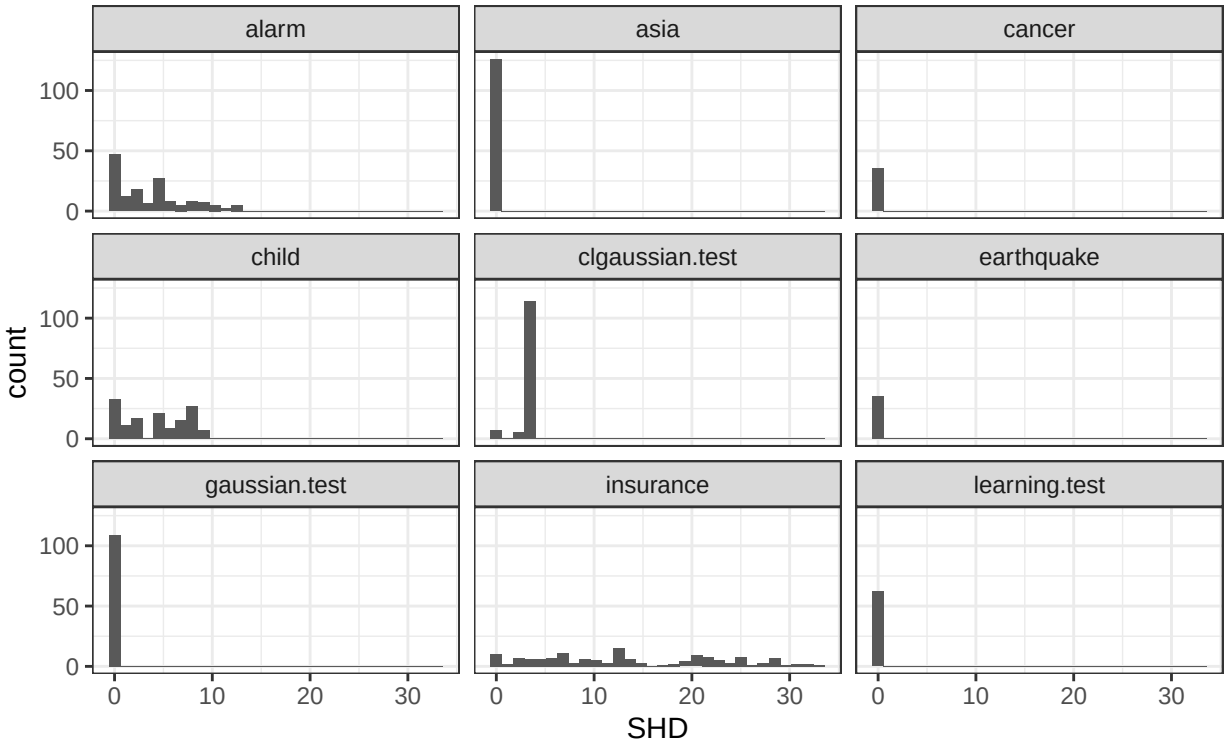
This is a preliminary display of the results. We are using a significance level of 0.005 for our hypothesis tests.

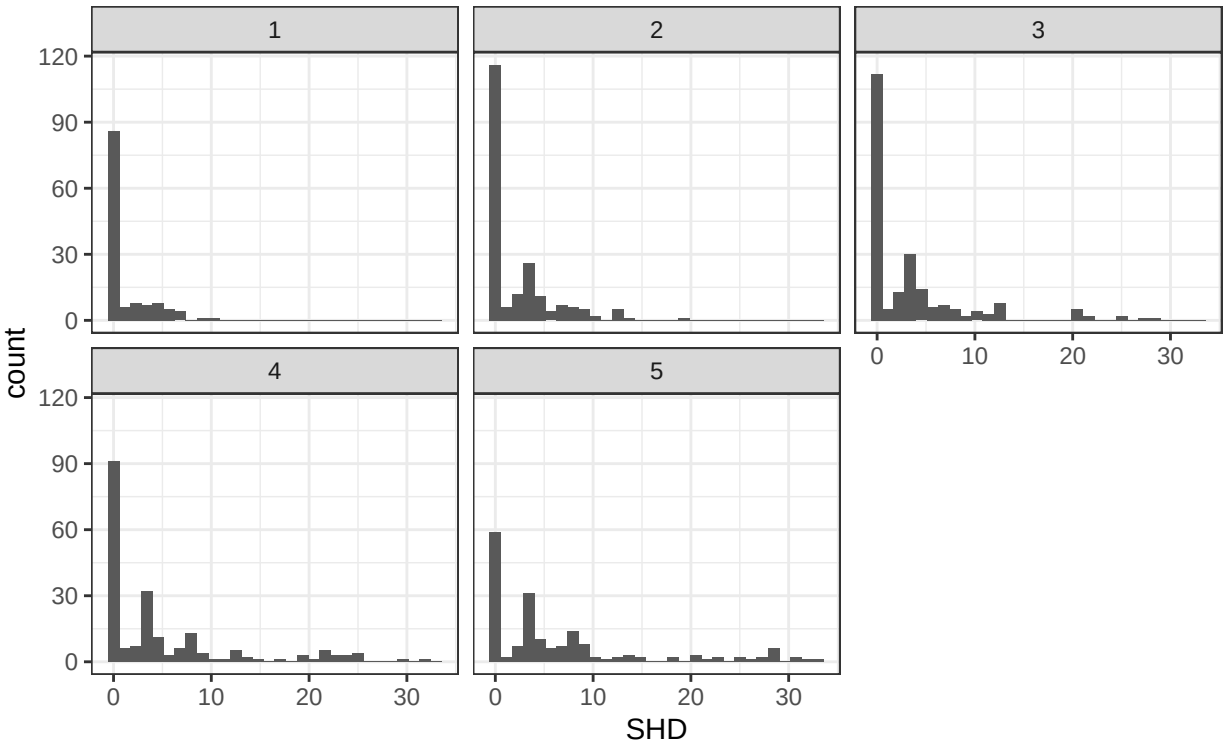
Same V-Structures

```
##
##   0   1
## 432 498
```

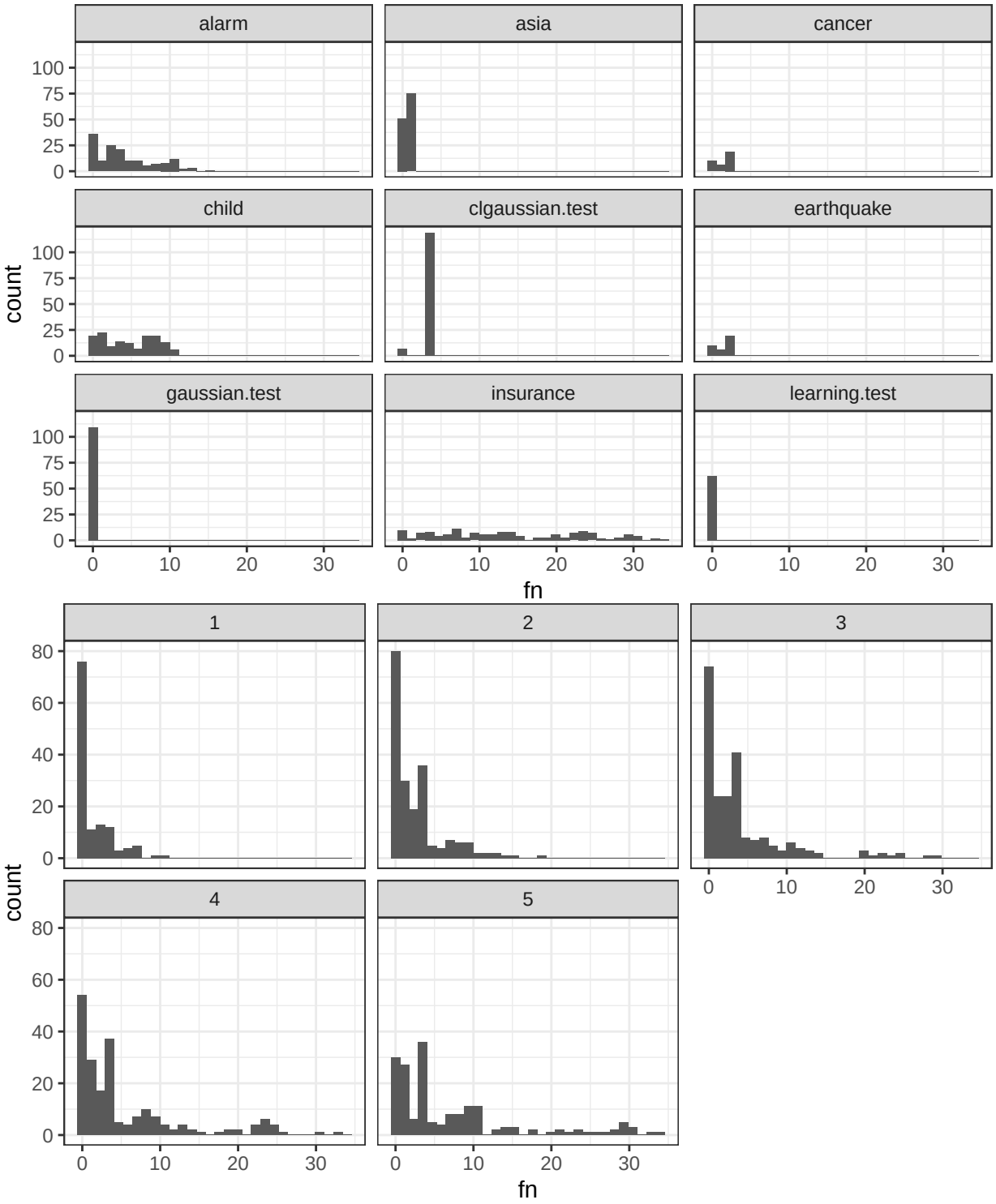
SHD

```
##
##   0   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  17  18
## 464  25  47 126  25  29  24  31  38  20  10   5   7  13   6   3   1   2
##  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33
##   4   5   4   8   5   3   8   1   3   2   5   1   2   2   1
```

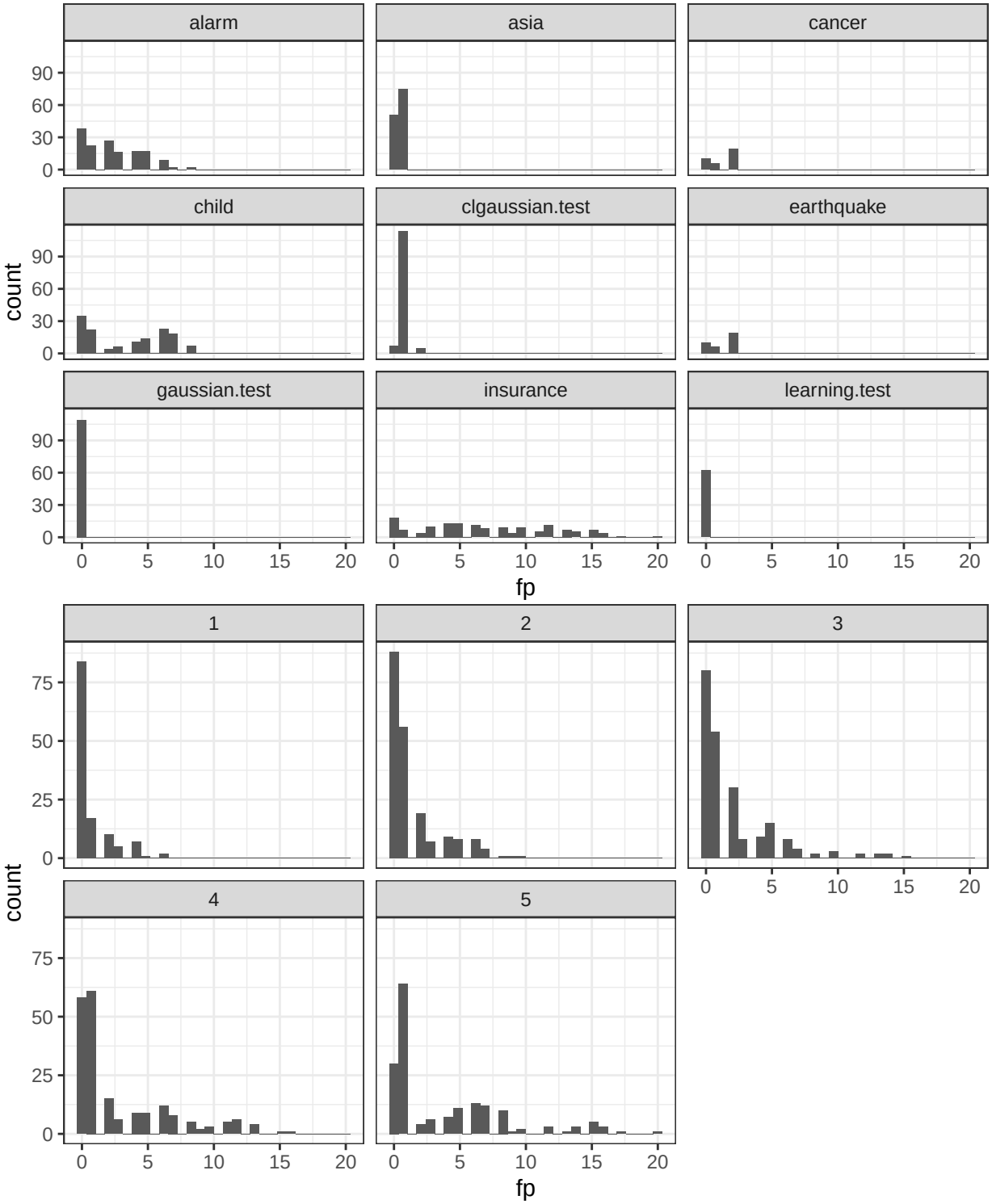



1
2
3
4
5
count
SHD
0
30
60
90
120
0
10
20
30

False Negatives

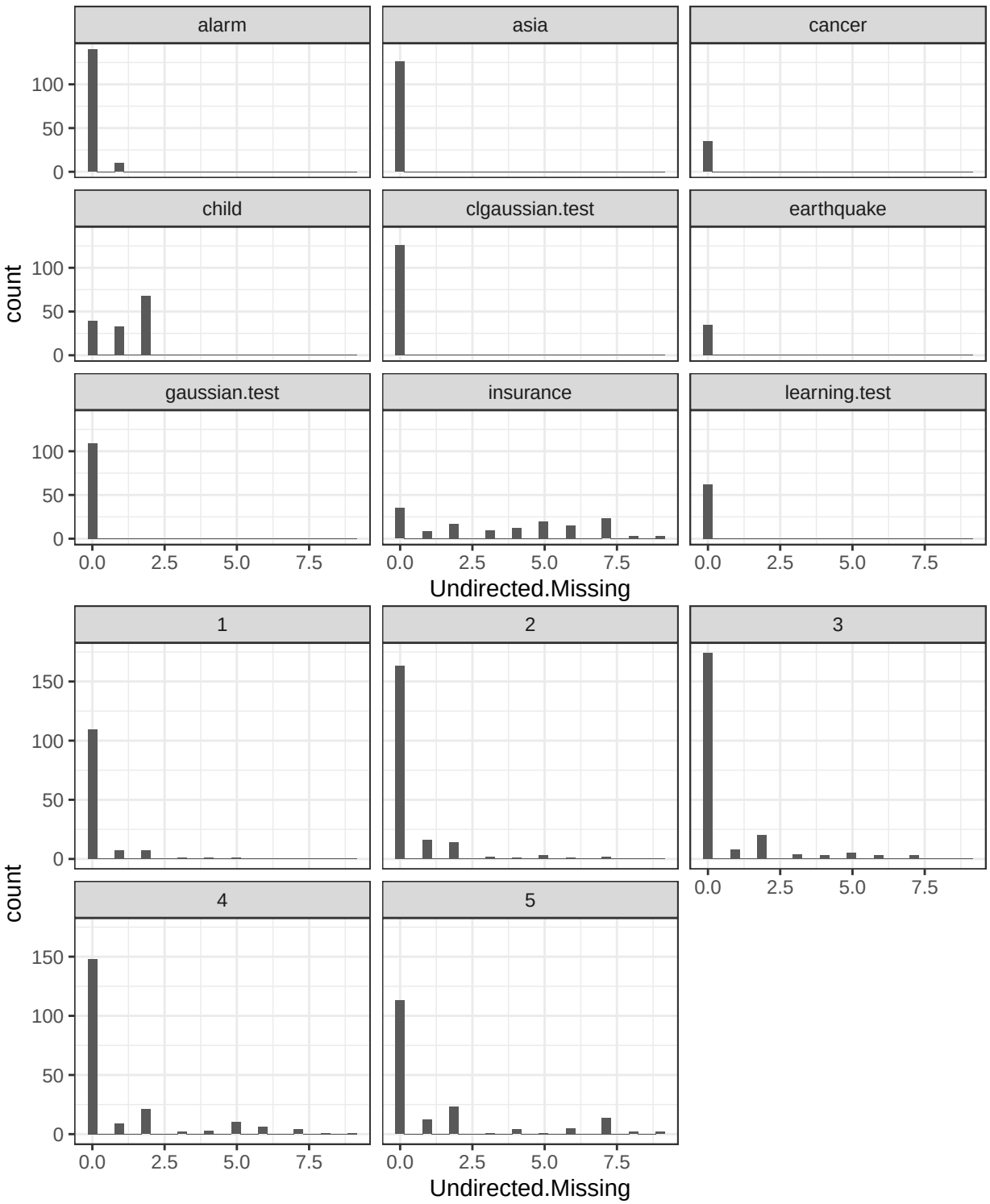


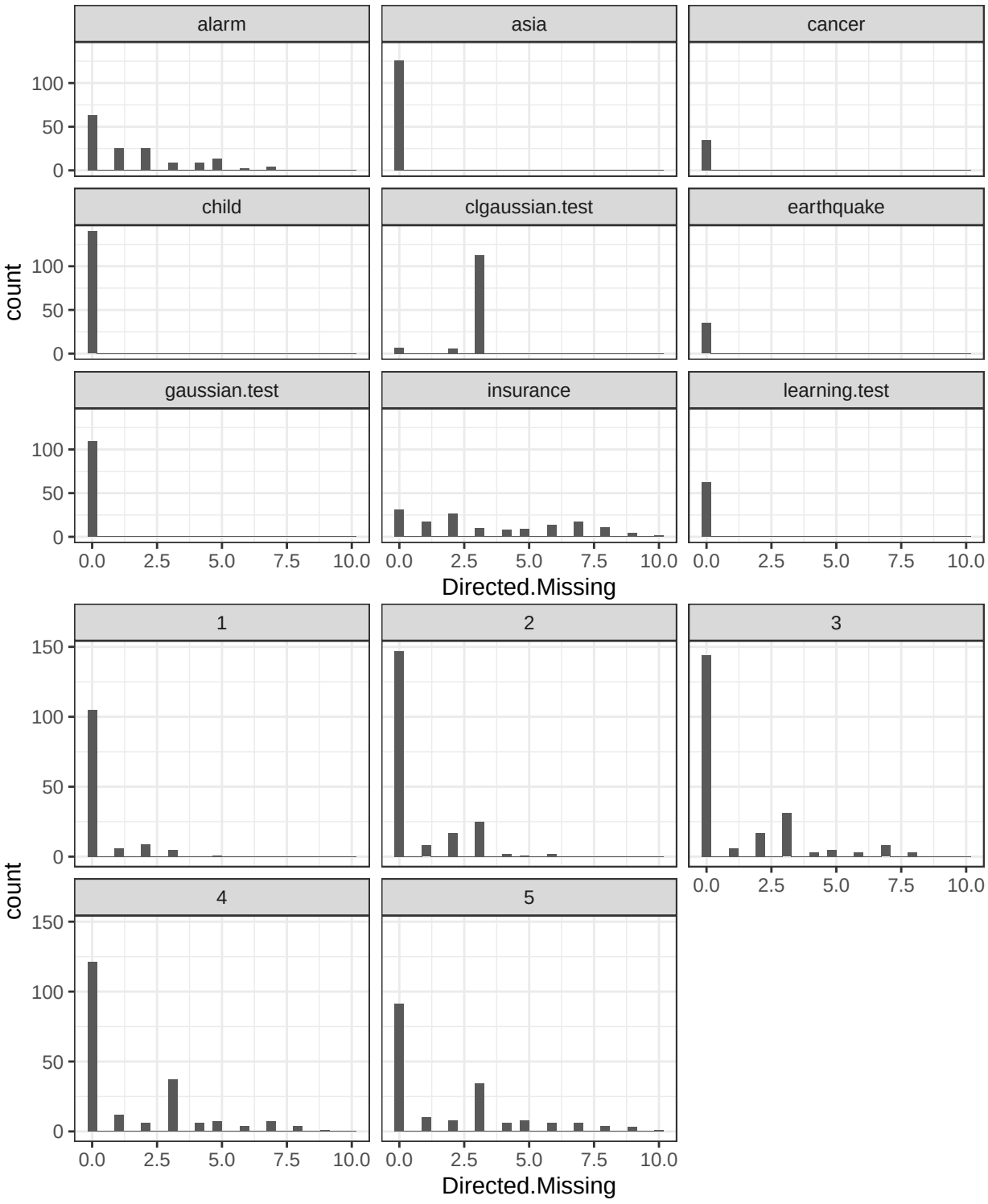
False Positives

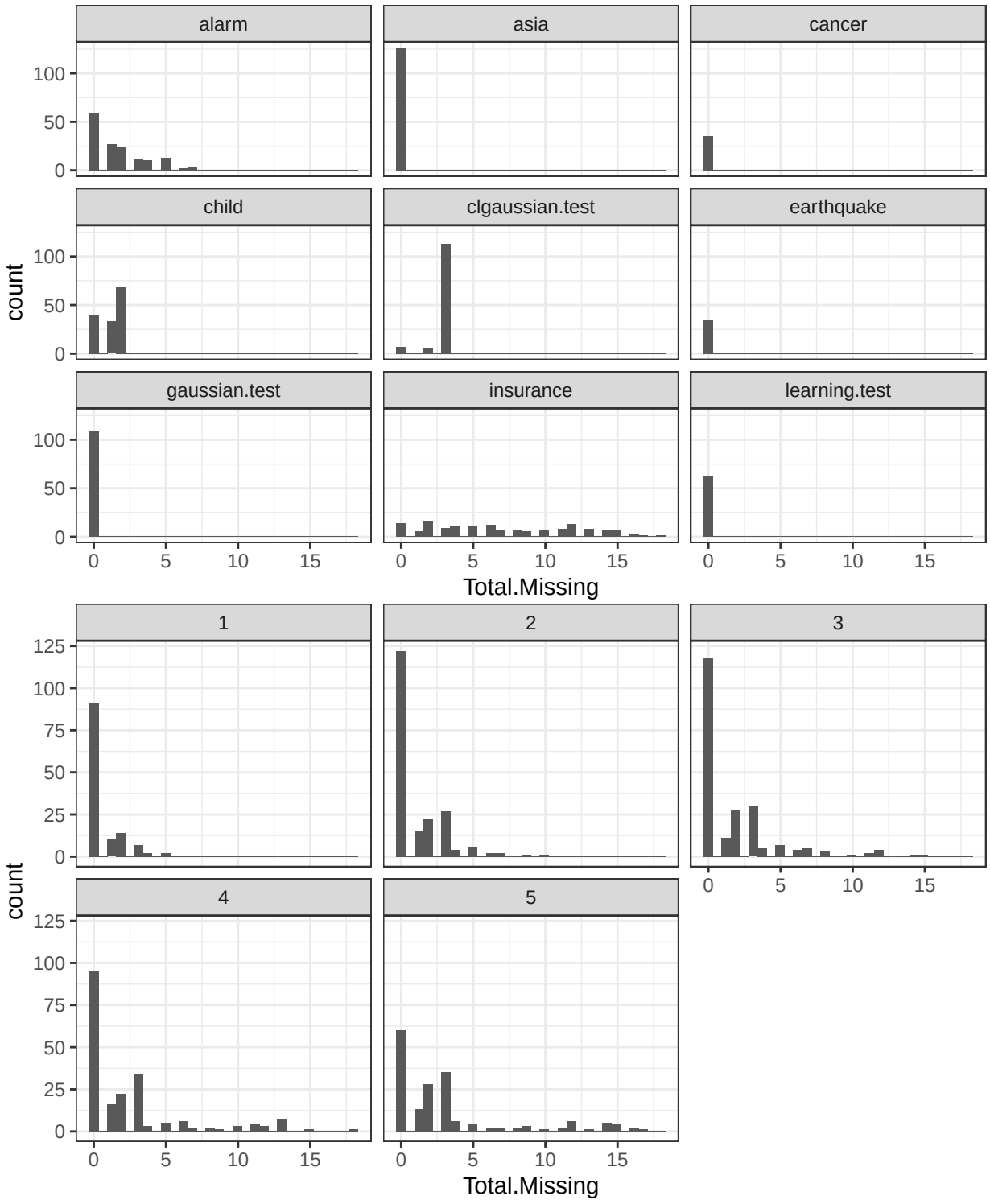


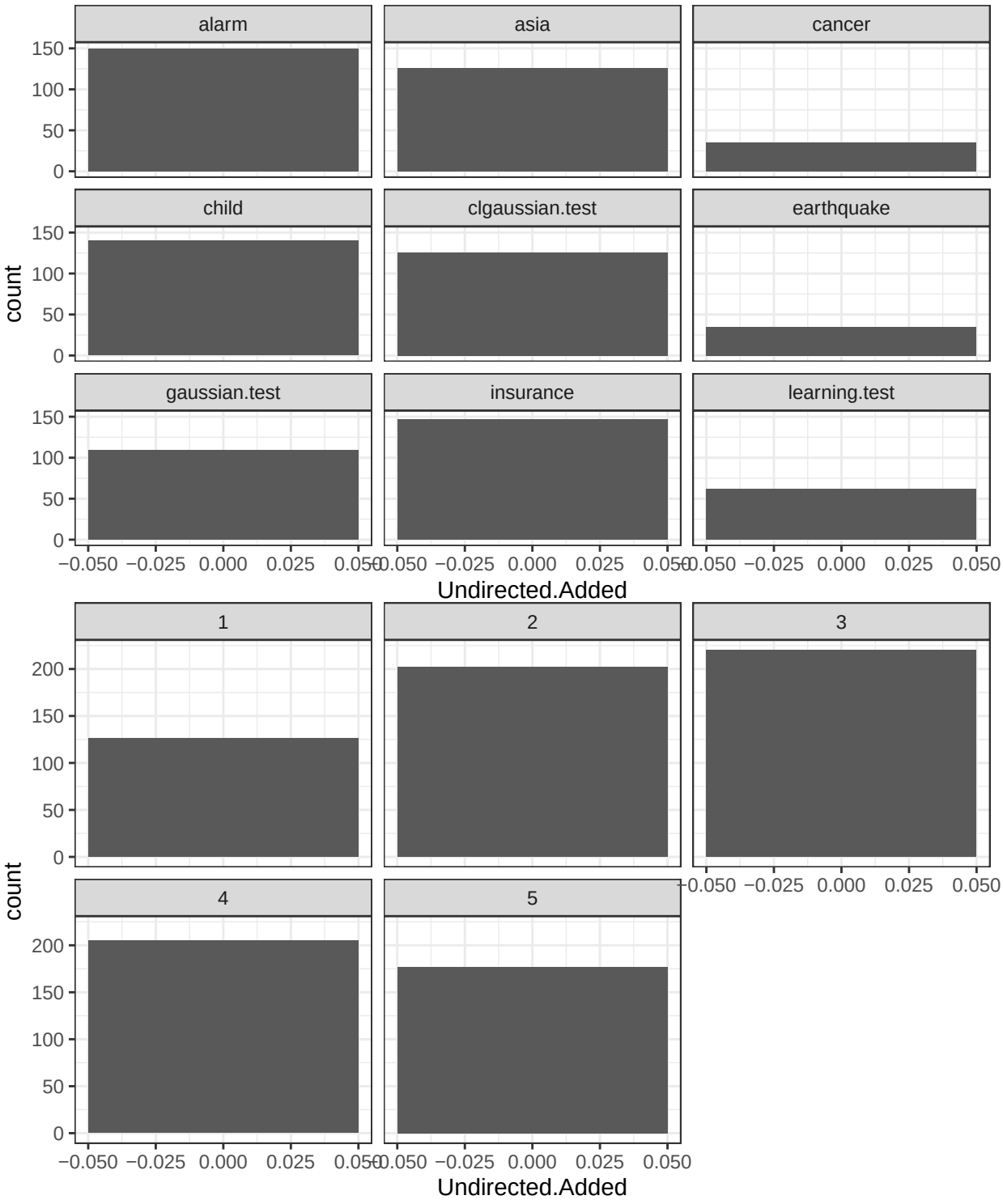
Distribution of Other Statistics

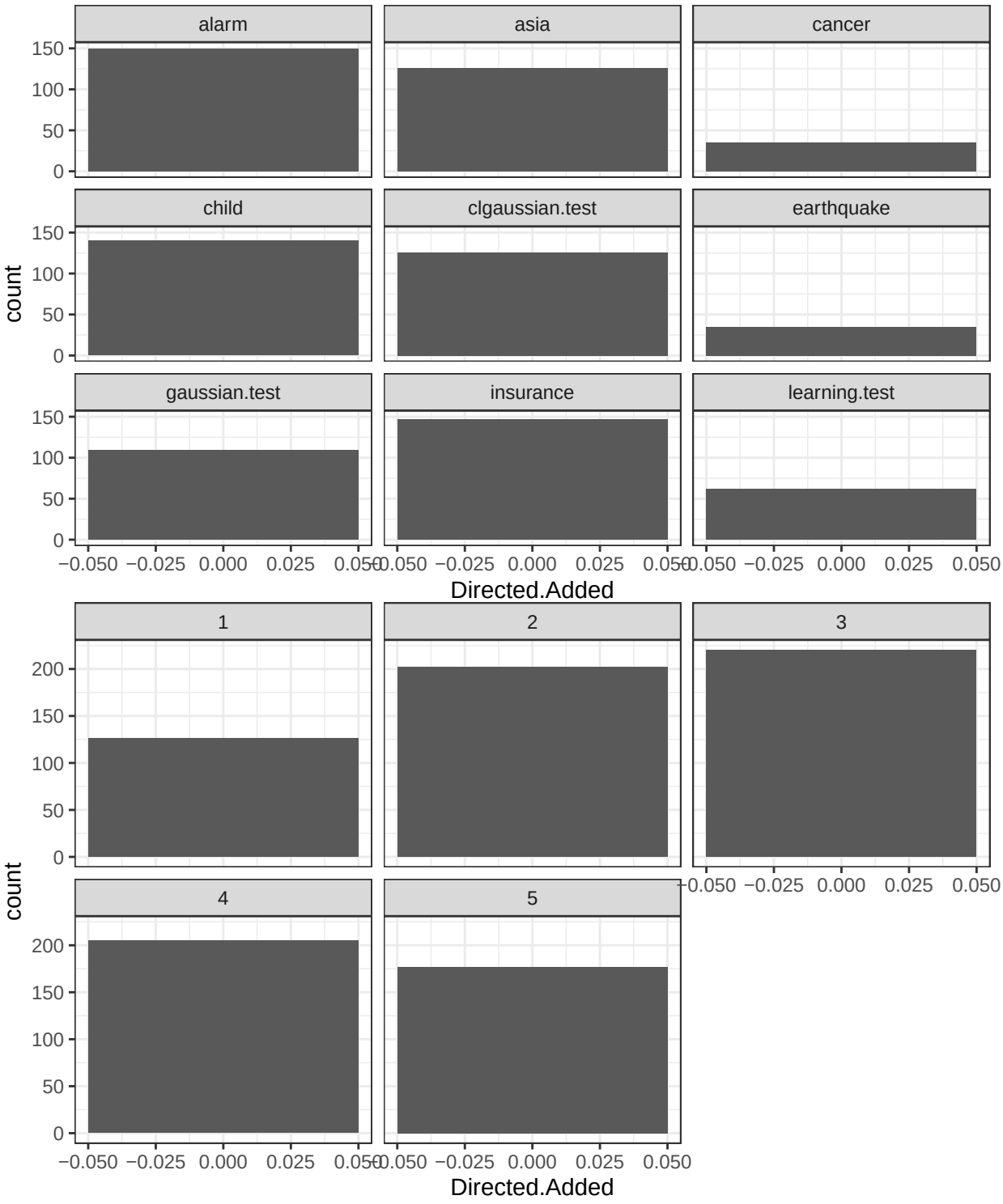
Undirected Edges Missing in Estimated CPDAG

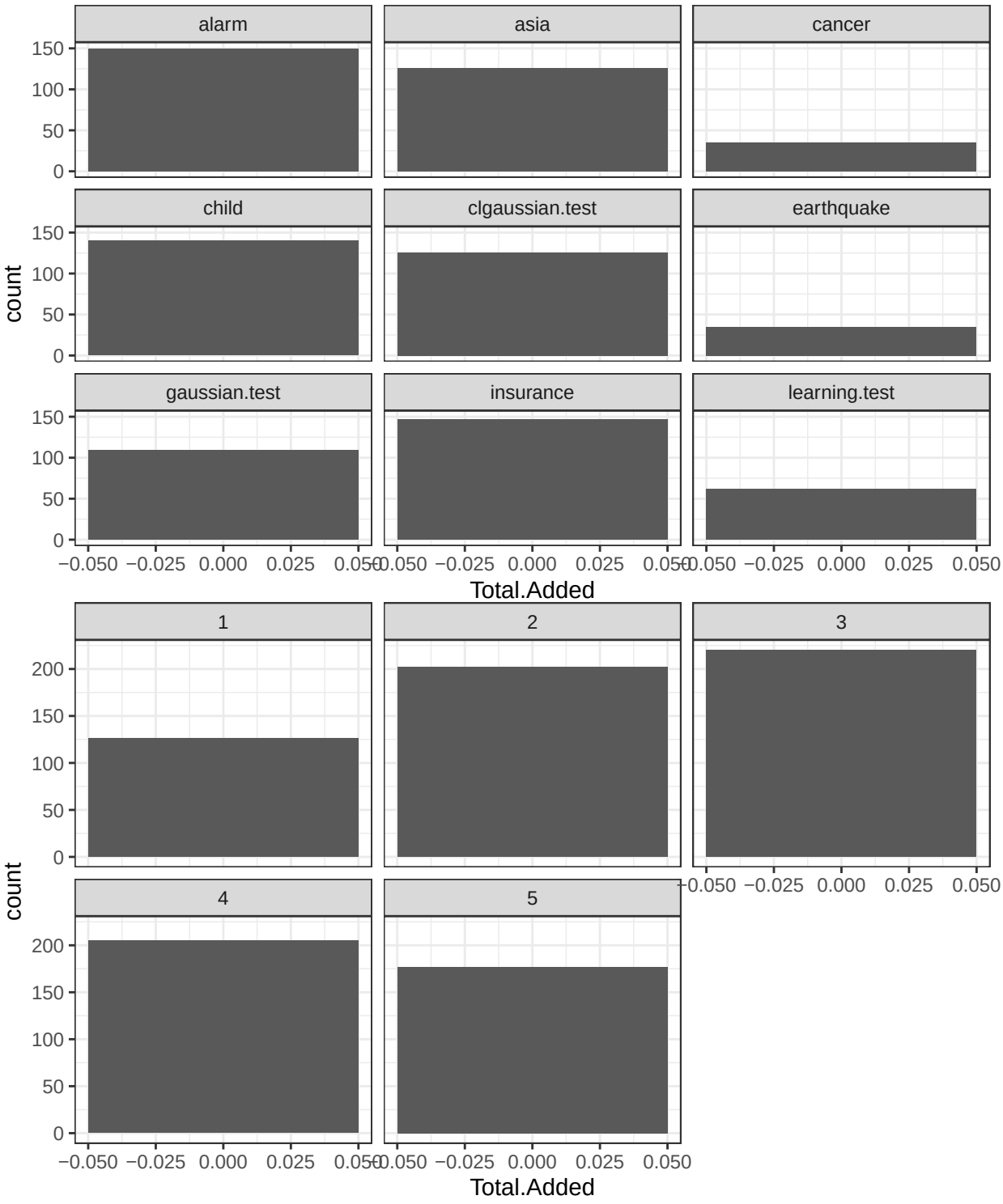


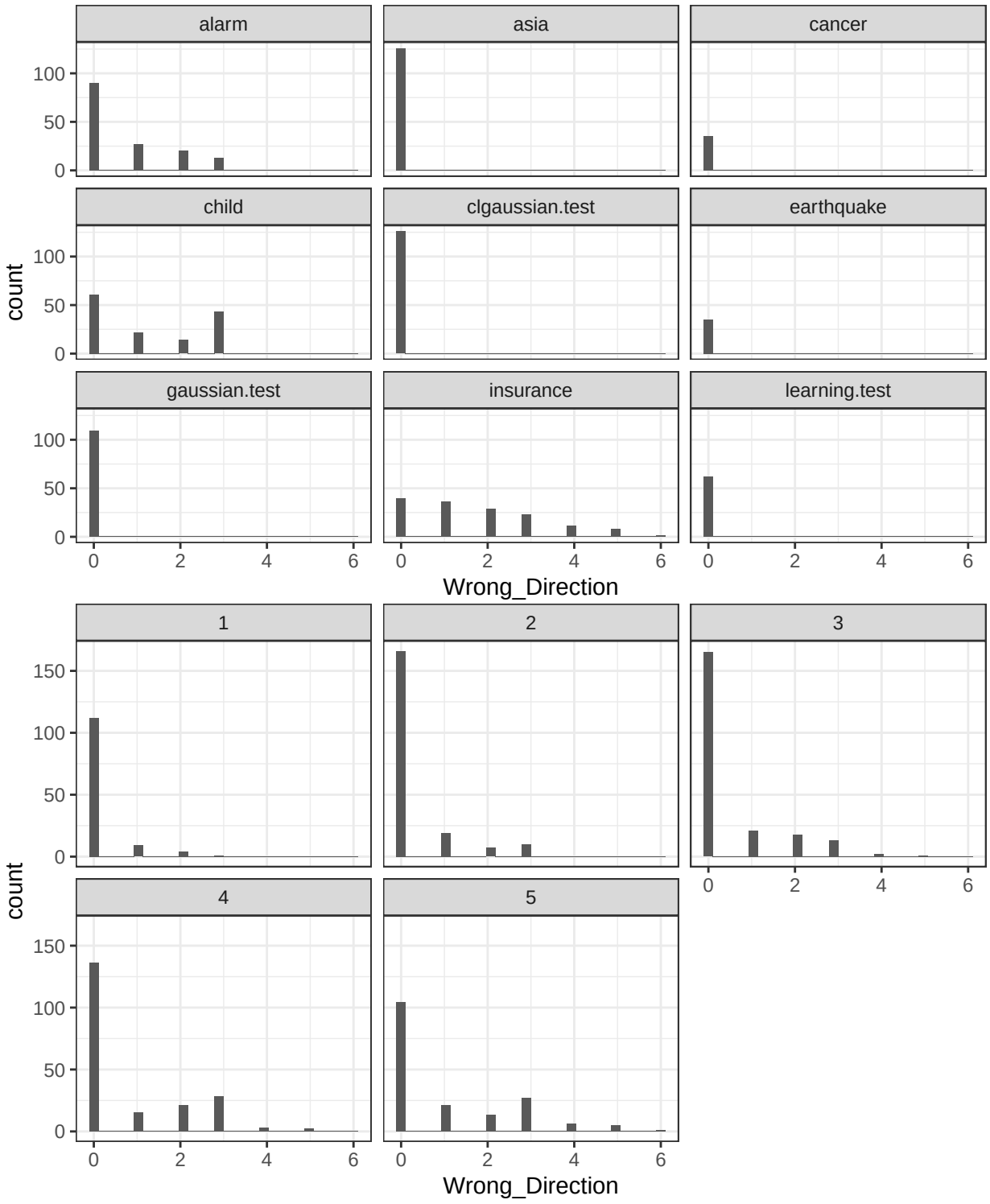

alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Directed.Missing
1
2
3
4
5
count
Directed.Missing

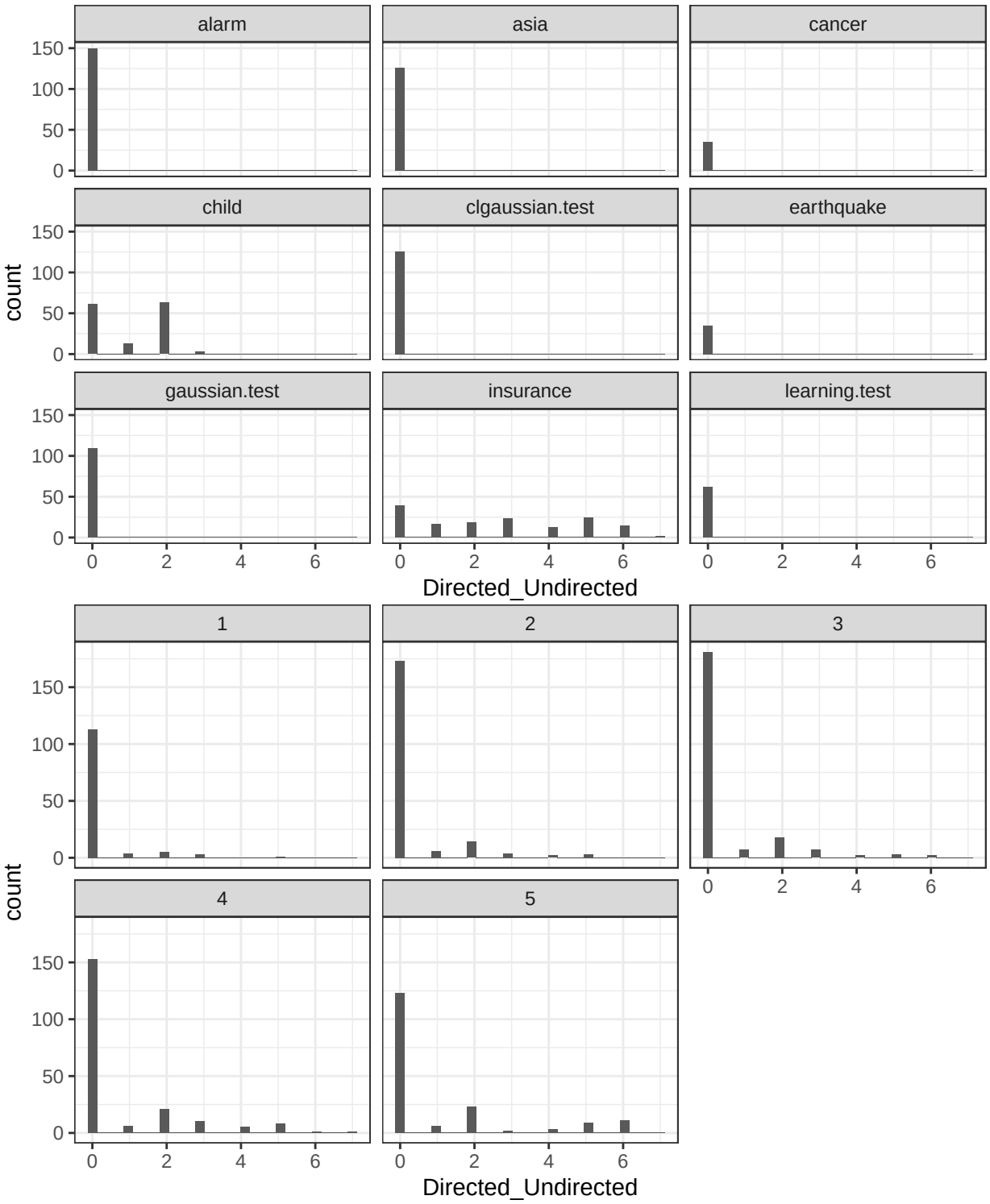

alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Total.Missing
1
2
3
4
5
count
Total.Missing

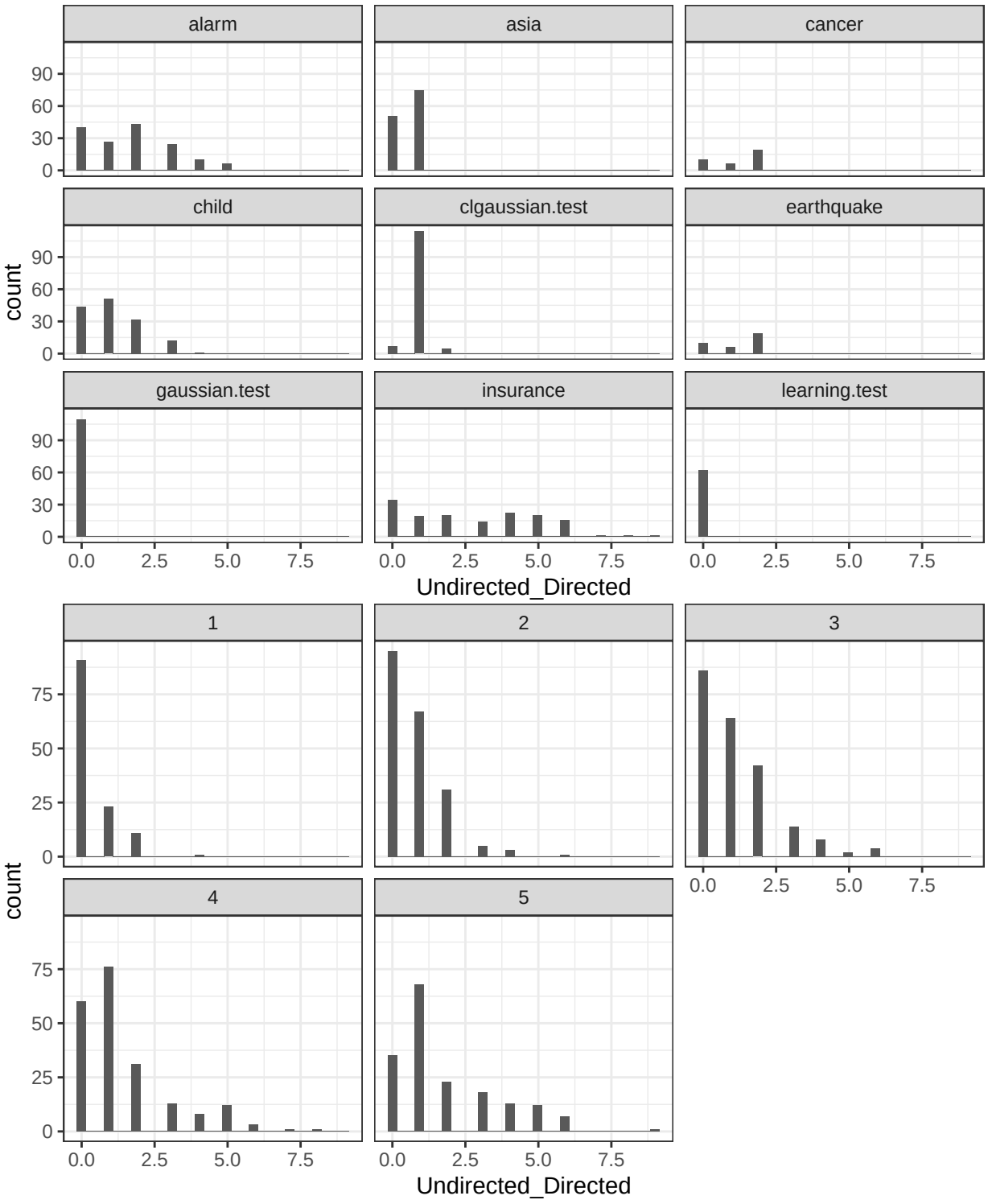

alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Undirected.Added
1
2
3
4
5
count
Undirected.Added


alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Directed.Added
1
2
3
4
5
count
Directed.Added


alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Total.Added
1
2
3
4
5
count
Total.Added


alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Wrong_Direction
1
2
3
4
5
count
Wrong_Direction


alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Directed_Undirected
1
2
3
4
5
count
Directed_Undirected


alarm
asia
cancer
child
clgaussian.test
earthquake
gaussian.test
insurance
learning.test
count
Undirected_Directed
1
2
3
4
5
count
Undirected_Directed