MasterWide

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In this document I show a possible way to analyze the MasterWide data from the file *MasterWide_StudyVI_TestScores_Sample.xlsx*. Also, for now I will only analyze the pre-test data. The code for the data management and these analyses is found in the file *TAMU.R*.

Step 1 - General settings and load libraries

Step 2 - Load and clean data

Then we load the data from the xlsx file and prepare the data. We remove the missing data rows and convert the original coding of "-1", "0", and "1" to "incorrect", "unknown", and "correct".

Step 3 - Summary of raw data

Here we see a table with summaries of the data:

```
## [1] "Pre-test data"
```

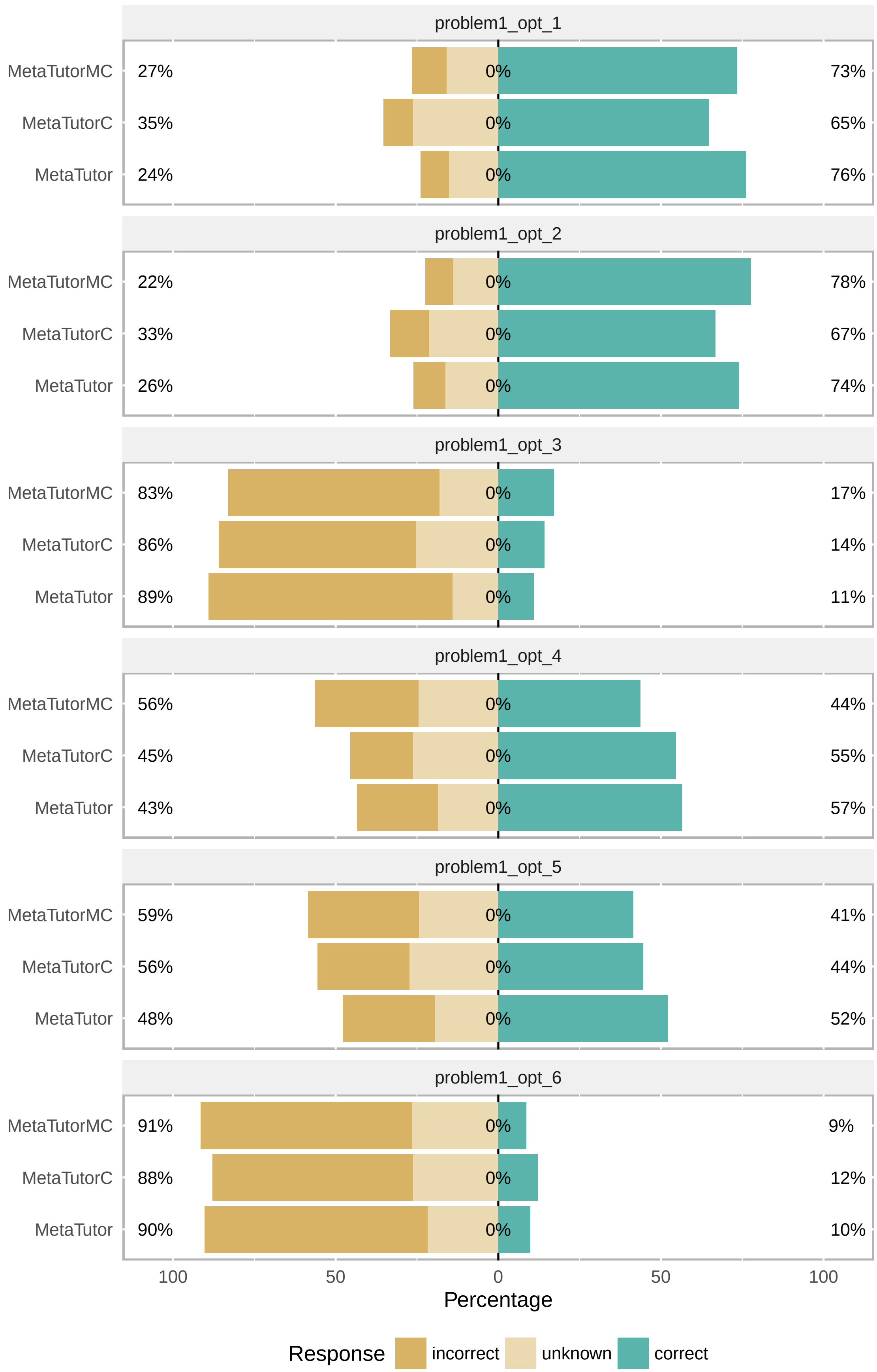
```
##
##   MetaTutor  MetaTutorC MetaTutorMC
##          92          99          94
```

```
## [1] "Post-test data"
```

```
##
##   MetaTutor  MetaTutorC MetaTutorMC
##          92          99          94
```

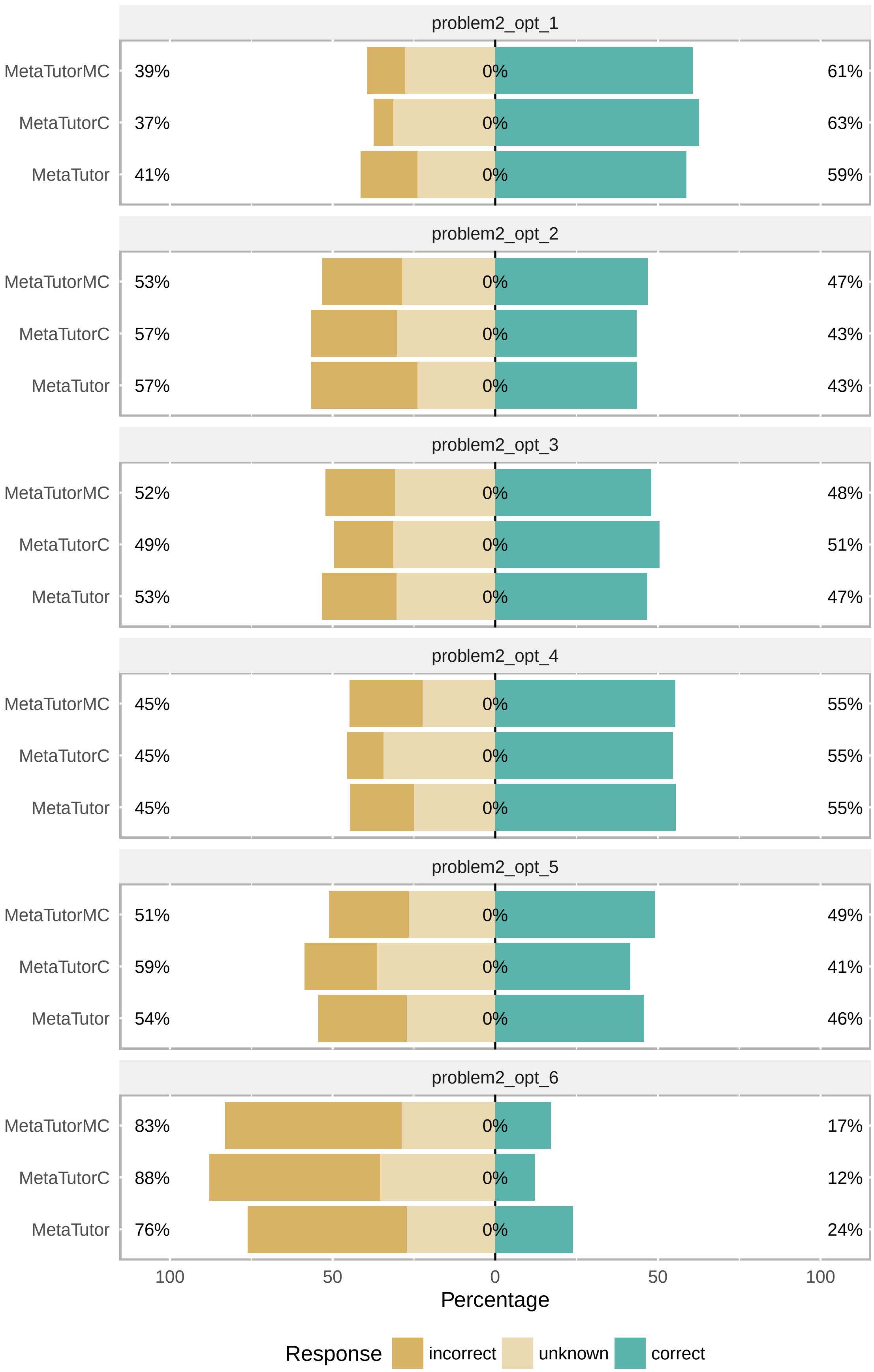
Step 4 - Create and Plot the Likert objects

The Likert plots are grouped by Condition. There are too many rows for all items, thus I break up the Likert object by the 3 problems, "Problem1", "Problem2", and "Eq_Problem". In addition, I shorten the variable names

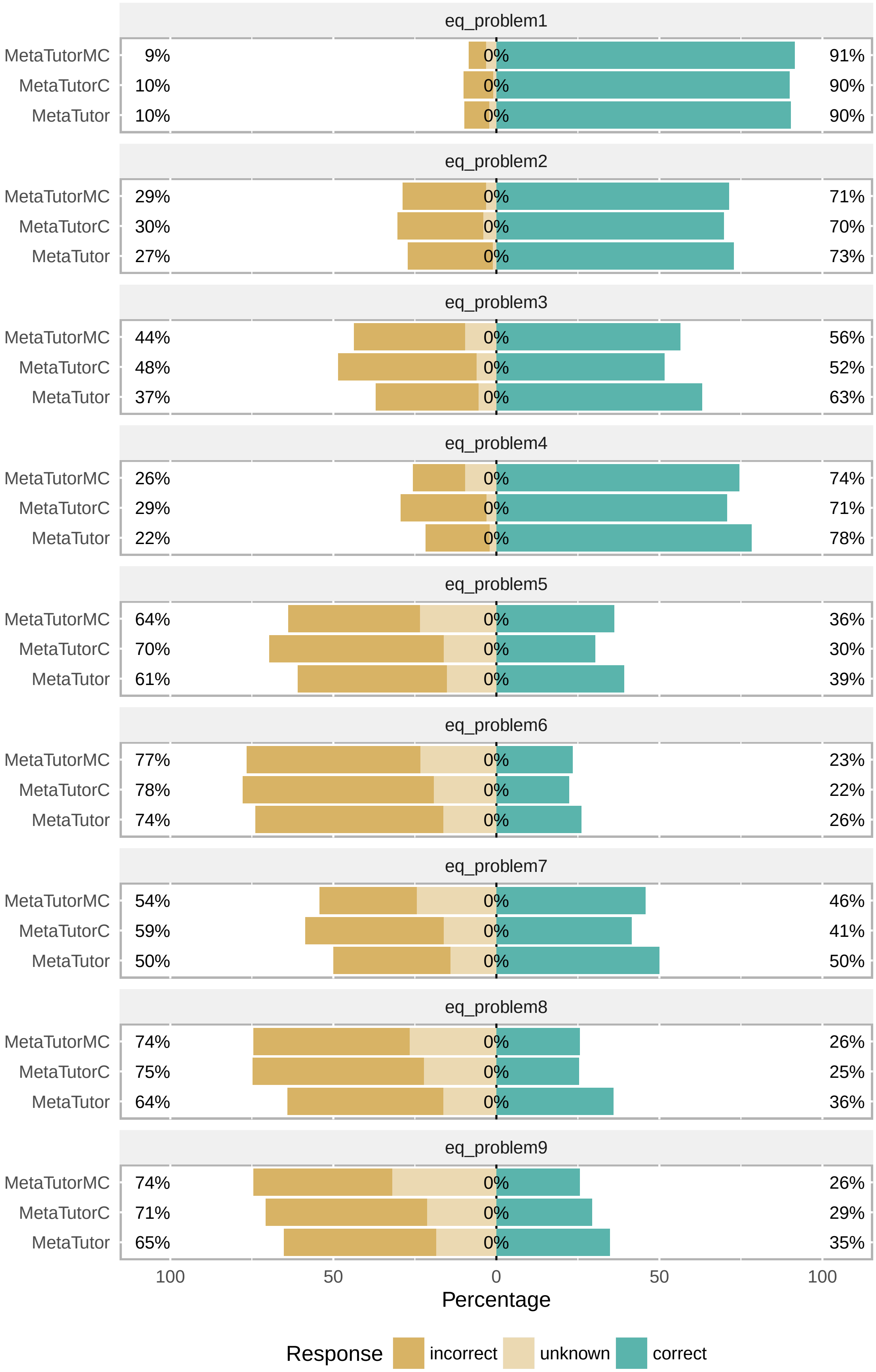


for the sake of leggibility.

```
## Saving 6.5 x 10 in image
```


problem2_opt_1
MetaTutorMC 39% 0% 61%
MetaTutorC 37% 0% 63%
MetaTutor 41% 0% 59%
problem2_opt_2
MetaTutorMC 53% 0% 47%
MetaTutorC 57% 0% 43%
MetaTutor 57% 0% 43%
problem2_opt_3
MetaTutorMC 52% 0% 48%
MetaTutorC 49% 0% 51%
MetaTutor 53% 0% 47%
problem2_opt_4
MetaTutorMC 45% 0% 55%
MetaTutorC 45% 0% 55%
MetaTutor 45% 0% 55%
problem2_opt_5
MetaTutorMC 51% 0% 49%
MetaTutorC 59% 0% 41%
MetaTutor 54% 0% 46%
problem2_opt_6
MetaTutorMC 83% 0% 17%
MetaTutorC 88% 0% 12%
MetaTutor 76% 0% 24%
100
50
0
50
100
Percentage
Response
incorrect
unknown
correct

```
## Saving 6.5 x 10 in image
```


eq_problem1
MetaTutorMC 9% 0% 91%
MetaTutorC 10% 0% 90%
MetaTutor 10% 0% 90%
eq_problem2
MetaTutorMC 29% 0% 71%
MetaTutorC 30% 0% 70%
MetaTutor 27% 0% 73%
eq_problem3
MetaTutorMC 44% 0% 56%
MetaTutorC 48% 0% 52%
MetaTutor 37% 0% 63%
eq_problem4
MetaTutorMC 26% 0% 74%
MetaTutorC 29% 0% 71%
MetaTutor 22% 0% 78%
eq_problem5
MetaTutorMC 64% 0% 36%
MetaTutorC 70% 0% 30%
MetaTutor 61% 0% 39%
eq_problem6
MetaTutorMC 77% 0% 23%
MetaTutorC 78% 0% 22%
MetaTutor 74% 0% 26%
eq_problem7
MetaTutorMC 54% 0% 46%
MetaTutorC 59% 0% 41%
MetaTutor 50% 0% 50%
eq_problem8
MetaTutorMC 74% 0% 26%
MetaTutorC 75% 0% 25%
MetaTutor 64% 0% 36%
eq_problem9
MetaTutorMC 74% 0% 26%
MetaTutorC 71% 0% 29%
MetaTutor 65% 0% 35%
100 50 0 50 100
Percentage
Response incorrect unknown correct

```
## Saving 6.5 x 10 in image
```

Step 5 - Statistical test for equality of proportions

Since we are looking at the pre-test data, we need to assure that they are fairly homogeneous among conditions before the treatment. Because the number of rows is unequal between conditions we should not use ANOVA or something similar. We should convert the data to proportions and test for equality of proportion. I do this using the Beta regression test, see: https://cran.r-project.org/web/packages/betareg/vignettes/betareg.pdf

For this analysis I convert the "unknown" and "incorrect" responses to zero and "correct" to one.

For ease of interpretation I also perform a two-way test of equality of proportion using the Chi-square test.

```
##
## Call:
## betareg(formula = value ~ Condition - 1, data = data_pre_proportion,
##     hessian = TRUE)
##
## Standardized weighted residuals 2:
##     Min      1Q  Median      3Q     Max
## -2.1532 -0.6020  0.0120  0.6342  2.4236
##
## Coefficients (mean model with logit link):
##                      Estimate Std. Error z value Pr(>|z|)
## ConditionMetaTutor   -0.02286    0.18430  -0.124    0.901
## ConditionMetaTutorC  -0.18322    0.18482  -0.991    0.322
## ConditionMetaTutorMC -0.11163    0.18449  -0.605    0.545
##
## Phi coefficients (precision model with identity link):
##       Estimate Std. Error z value       Pr(>|z|)
## (phi)   4.4641     0.7223   6.181 0.000000000637
##
## Type of estimator: ML (maximum likelihood)
## Log-likelihood: 10.33 on 4 Df
## Pseudo R-squared: 0.006065
## Number of iterations in BFGS optimization: 12
```

```
## [1] "MetaTutor vs. MetaTutorC"
```

```
## [1] "problem1_opt_1"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 2.4596, df = 1, p-value = 0.1168
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.02439818  0.25320802
## sample estimates:
##    prop 1    prop 2
## 0.7608696 0.6464646
##
```

```
## [1] "problem1_opt_2"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 0.8749, df = 1, p-value = 0.3496
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.06714882  0.21207635
## sample estimates:
##    prop 1    prop 2
## 0.7391304 0.6666667
##
## [1] "problem1_opt_3"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 0.21455, df = 1, p-value = 0.6432
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.13678009  0.07134311
## sample estimates:
##    prop 1    prop 2
## 0.1086957 0.1414141
##
## [1] "problem1_opt_4"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 0.016619, df = 1, p-value = 0.8974
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1317247  0.1712504
## sample estimates:
##    prop 1    prop 2
## 0.5652174 0.5454545
##
## [1] "problem1_opt_5"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 0.85253, df = 1, p-value = 0.3558
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.07461163  0.22920100
## sample estimates:
##    prop 1    prop 2
```

```
## 0.5217391 0.4444444
##
## [1] "problem1_opt_6"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 0.081099, df = 1, p-value = 0.7758
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.12229292  0.07552085
## sample estimates:
##     prop 1     prop 2
## 0.09782609 0.12121212
##
## [1] "problem2_opt_1"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 0.16609, df = 1, p-value = 0.6836
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1883738  0.1097615
## sample estimates:
##    prop 1    prop 2
## 0.5869565 0.6262626
##
## [1] "problem2_opt_2"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 0.000000000000000000000000000000027886, df = 1, p-value
## = 1
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1406930  0.1415714
## sample estimates:
##    prop 1    prop 2
## 0.4347826 0.4343434
##
## [1] "problem2_opt_3"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 0.14095, df = 1, p-value = 0.7073
## alternative hypothesis: two.sided
## 95 percent confidence interval:
```

```
##  -0.1898978  0.1145794
## sample estimates:
##    prop 1    prop 2
## 0.4673913 0.5050505
##
## [1] "problem2_opt_4"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 0.000000000000000000000000000014186, df = 1, p-value
## = 1
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1411945  0.1589811
## sample estimates:
##    prop 1    prop 2
## 0.5543478 0.5454545
##
## [1] "problem2_opt_5"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 0.19742, df = 1, p-value = 0.6568
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1087265  0.1934872
## sample estimates:
##    prop 1    prop 2
## 0.4565217 0.4141414
##
## [1] "problem2_opt_6"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 3.7614, df = 1, p-value = 0.05245
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.0008741395  0.2367107666
## sample estimates:
##    prop 1    prop 2
## 0.2391304 0.1212121
##
## [1] "eq_problem1"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
```

```
## X-squared = 0.0000000000000000000000000000053399, df = 1, p-value
## = 1
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.08490398  0.09127201
## sample estimates:
##    prop 1    prop 2
## 0.9021739 0.8989899
##
## [1] "eq_problem2"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 0.10068, df = 1, p-value = 0.751
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1074845  0.1700668
## sample estimates:
##    prop 1    prop 2
## 0.7282609 0.6969697
##
## [1] "eq_problem3"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 2.1376, df = 1, p-value = 0.1437
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.03455806  0.26512459
## sample estimates:
##    prop 1    prop 2
## 0.6304348 0.5151515
##
## [1] "eq_problem4"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 1.058, df = 1, p-value = 0.3037
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.057995  0.209071
## sample estimates:
##    prop 1    prop 2
## 0.7826087 0.7070707
##
## [1] "eq_problem5"
##
##  2-sample test for equality of proportions with continuity
```

```
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 1.276, df = 1, p-value = 0.2587
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.05689847  0.23344656
## sample estimates:
##    prop 1    prop 2
## 0.3913043 0.3030303
##
## [1] "eq_problem6"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 0.20685, df = 1, p-value = 0.6492
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.09331914  0.17061383
## sample estimates:
##    prop 1    prop 2
## 0.2608696 0.2222222
##
## [1] "eq_problem7"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 1.0923, df = 1, p-value = 0.296
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.06552865  0.23724582
## sample estimates:
##    prop 1    prop 2
## 0.5000000 0.4141414
##
## [1] "eq_problem8"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 2.0647, df = 1, p-value = 0.1507
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.03442739  0.24676819
## sample estimates:
##    prop 1    prop 2
## 0.3586957 0.2525253
##
## [1] "eq_problem9"
```

```
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutorc_sums[i]) out of c(metatutor_count, metatutorc_count)
## X-squared = 0.43269, df = 1, p-value = 0.5107
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.08790892  0.19770251
## sample estimates:
##    prop 1    prop 2
## 0.3478261 0.2929293

## [1] "MetaTutor vs. MetaTutorMC"

## [1] "problem1_opt_1"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.063608, df = 1, p-value = 0.8009
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1087281  0.1623821
## sample estimates:
##    prop 1    prop 2
## 0.7608696 0.7340426
##
## [1] "problem1_opt_2"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.18088, df = 1, p-value = 0.6706
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.17126881  0.09633819
## sample estimates:
##    prop 1    prop 2
## 0.7391304 0.7765957
##
## [1] "problem1_opt_3"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.9964, df = 1, p-value = 0.3182
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.17135320  0.04831897
## sample estimates:
```

```
##    prop 1    prop 2
## 0.1086957 0.1702128
##
## [1] "problem1_opt_4"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 2.6025, df = 1, p-value = 0.1067
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.02422446  0.28231881
## sample estimates:
##    prop 1    prop 2
## 0.5652174 0.4361702
##
## [1] "problem1_opt_5"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 1.7244, df = 1, p-value = 0.1891
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.04652559  0.26021662
## sample estimates:
##    prop 1    prop 2
## 0.5217391 0.4148936
##
## [1] "problem1_opt_6"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.0021635, df = 1, p-value = 0.9629
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.08090244  0.10634185
## sample estimates:
##     prop 1     prop 2
## 0.09782609 0.08510638
##
## [1] "problem2_opt_1"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.014532, df = 1, p-value = 0.904
## alternative hypothesis: two.sided
## 95 percent confidence interval:
```

```
##  -0.1711668  0.1323139
## sample estimates:
##    prop 1    prop 2
## 0.5869565 0.6063830
##
## [1] "problem2_opt_2"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.095452, df = 1, p-value = 0.7574
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1870116  0.1204066
## sample estimates:
##    prop 1    prop 2
## 0.4347826 0.4680851
##
## [1] "problem2_opt_3"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.000062349, df = 1, p-value = 0.9937
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1655869  0.1429227
## sample estimates:
##    prop 1    prop 2
## 0.4673913 0.4787234
##
## [1] "problem2_opt_4"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.0000000000000000000000000000044831, df = 1, p-value
## = 1
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1428861  0.1451988
## sample estimates:
##    prop 1    prop 2
## 0.5543478 0.5531915
##
## [1] "problem2_opt_5"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
```

```
## X-squared = 0.090982, df = 1, p-value = 0.7629
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1870227  0.1213428
## sample estimates:
##    prop 1    prop 2
## 0.4565217 0.4893617
##
## [1] "problem2_opt_6"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.96758, df = 1, p-value = 0.3253
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.05746156  0.19529690
## sample estimates:
##    prop 1    prop 2
## 0.2391304 0.1702128
##
## [1] "eq_problem1"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.0021635, df = 1, p-value = 0.9629
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.10634185  0.08090244
## sample estimates:
##    prop 1    prop 2
## 0.9021739 0.9148936
##
## [1] "eq_problem2"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.0051887, df = 1, p-value = 0.9426
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1242157  0.1552055
## sample estimates:
##    prop 1    prop 2
## 0.7282609 0.7127660
##
## [1] "eq_problem3"
##
##  2-sample test for equality of proportions with continuity
##  correction
```

```
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.60271, df = 1, p-value = 0.4375
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.08478501  0.21799500
## sample estimates:
##    prop 1    prop 2
## 0.6304348 0.5638298
##
## [1] "eq_problem4"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.1901, df = 1, p-value = 0.6628
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.09478464  0.17064033
## sample estimates:
##    prop 1    prop 2
## 0.7826087 0.7446809
##
## [1] "eq_problem5"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.070375, df = 1, p-value = 0.7908
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1203654  0.1795698
## sample estimates:
##    prop 1    prop 2
## 0.3913043 0.3617021
##
## [1] "eq_problem6"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.064527, df = 1, p-value = 0.7995
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1079312  0.1615853
## sample estimates:
##    prop 1    prop 2
## 0.2608696 0.2340426
##
## [1] "eq_problem7"
##
```

```
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 0.18841, df = 1, p-value = 0.6642
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1116629  0.1967693
## sample estimates:
##    prop 1    prop 2
## 0.5000000 0.4574468
##
## [1] "eq_problem8"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 1.8767, df = 1, p-value = 0.1707
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.03919186  0.24594487
## sample estimates:
##    prop 1    prop 2
## 0.3586957 0.2553191
##
## [1] "eq_problem9"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutor_sums[i], metatutormc_sums[i]) out of c(metatutor_count, metatutormc_count)
## X-squared = 1.4767, df = 1, p-value = 0.2243
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.04955521  0.23456908
## sample estimates:
##    prop 1    prop 2
## 0.3478261 0.2553191
```

```
## [1] "MetaTutorC vs. MetaTutorMC"
```

```
## [1] "problem1_opt_1"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 1.3417, df = 1, p-value = 0.2467
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.22774126  0.05258545
## sample estimates:
##    prop 1    prop 2
```

```
## 0.6464646 0.7340426
##
## [1] "problem1_opt_2"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 2.3718, df = 1, p-value = 0.1235
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.24565001  0.02579185
## sample estimates:
##    prop 1    prop 2
## 0.6666667 0.7765957
##
## [1] "problem1_opt_3"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.12474, df = 1, p-value = 0.7239
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1415562  0.0839589
## sample estimates:
##    prop 1    prop 2
## 0.1414141 0.1702128
##
## [1] "problem1_opt_4"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 1.8875, df = 1, p-value = 0.1695
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.04133734  0.25990600
## sample estimates:
##    prop 1    prop 2
## 0.5454545 0.4361702
##
## [1] "problem1_opt_5"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.072377, df = 1, p-value = 0.7879
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1204667  0.1795684
```

```
## sample estimates:
##    prop 1    prop 2
## 0.4444444 0.4148936
##
## [1] "problem1_opt_6"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.34382, df = 1, p-value = 0.5576
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.05979316  0.13200463
## sample estimates:
##     prop 1     prop 2
## 0.12121212 0.08510638
##
## [1] "problem2_opt_1"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.018446, df = 1, p-value = 0.892
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1277350  0.1674943
## sample estimates:
##    prop 1    prop 2
## 0.6262626 0.6063830
##
## [1] "problem2_opt_2"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.10639, df = 1, p-value = 0.7443
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1844980  0.1170146
## sample estimates:
##    prop 1    prop 2
## 0.4343434 0.4680851
##
## [1] "problem2_opt_3"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.049124, df = 1, p-value = 0.8246
## alternative hypothesis: two.sided
```

```
## 95 percent confidence interval:
##  -0.1251021  0.1777564
## sample estimates:
##    prop 1    prop 2
## 0.5050505 0.4787234
##
## [1] "problem2_opt_4"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.000000000000000000000000000032103, df = 1, p-value
## = 1
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1559072  0.1404333
## sample estimates:
##    prop 1    prop 2
## 0.5454545 0.5531915
##
## [1] "problem2_opt_5"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.81908, df = 1, p-value = 0.3655
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.22568503  0.07524445
## sample estimates:
##    prop 1    prop 2
## 0.4141414 0.4893617
##
## [1] "problem2_opt_6"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.58016, df = 1, p-value = 0.4462
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.15889545  0.06089416
## sample estimates:
##    prop 1    prop 2
## 0.1212121 0.1702128
##
## [1] "eq_problem1"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
```

```
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.017462, df = 1, p-value = 0.8949
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.10816084  0.07635341
## sample estimates:
##    prop 1    prop 2
## 0.8989899 0.9148936
##
## [1] "eq_problem2"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.0068228, df = 1, p-value = 0.9342
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1548588  0.1232663
## sample estimates:
##    prop 1    prop 2
## 0.6969697 0.7127660
##
## [1] "eq_problem3"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.28477, df = 1, p-value = 0.5936
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1995538  0.1021972
## sample estimates:
##    prop 1    prop 2
## 0.5151515 0.5638298
##
## [1] "eq_problem4"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.17962, df = 1, p-value = 0.6717
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.17370521  0.09848493
## sample estimates:
##    prop 1    prop 2
## 0.7070707 0.7446809
##
## [1] "eq_problem5"
##
##  2-sample test for equality of proportions with continuity
```

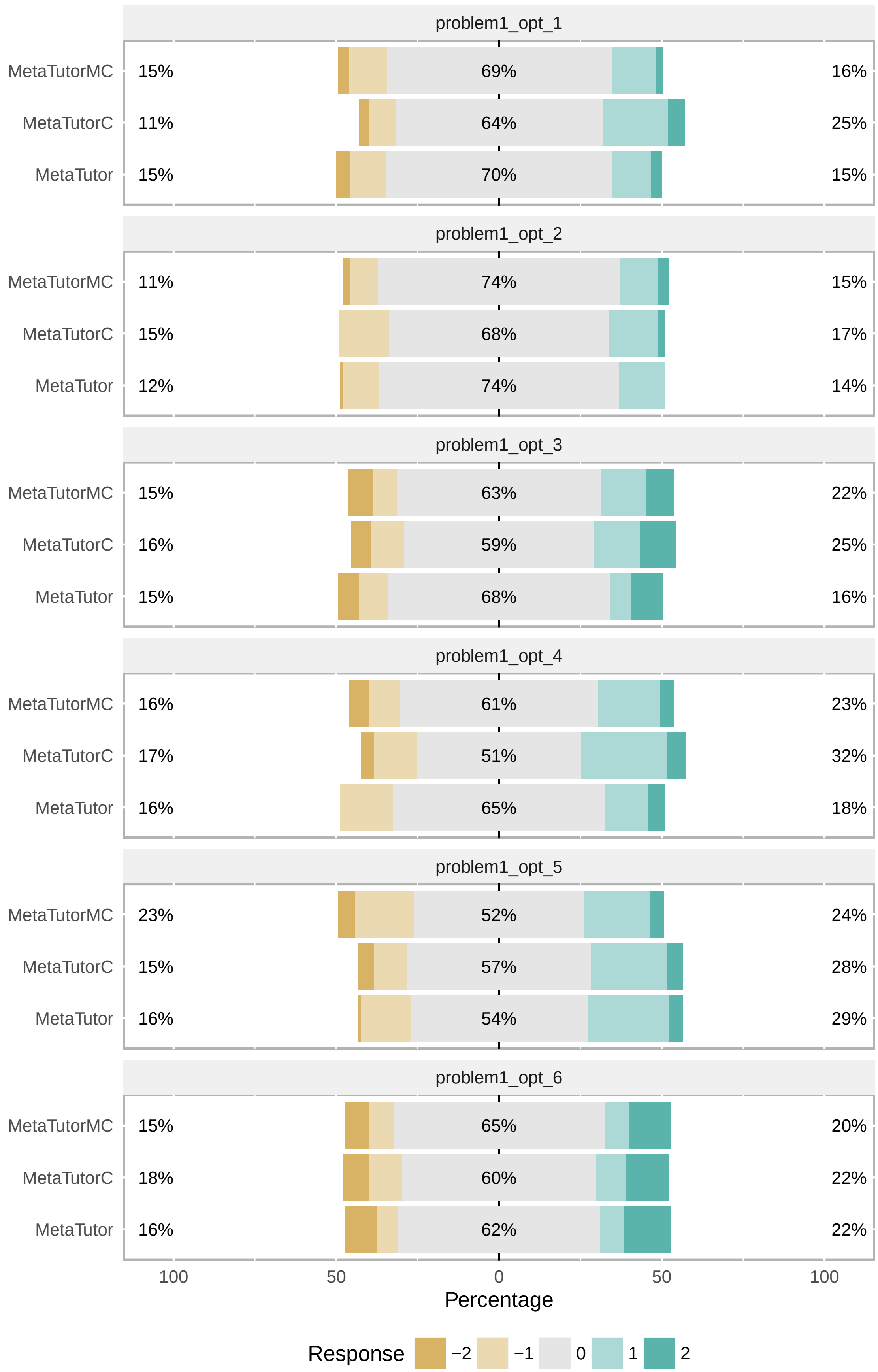
```
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.50756, df = 1, p-value = 0.4762
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.20182041  0.08447676
## sample estimates:
##    prop 1    prop 2
## 0.3030303 0.3617021
##
## [1] "eq_problem6"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.00057653, df = 1, p-value = 0.9808
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1406494  0.1170088
## sample estimates:
##    prop 1    prop 2
## 0.2222222 0.2340426
##
## [1] "eq_problem7"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.21279, df = 1, p-value = 0.6446
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1935223  0.1069115
## sample estimates:
##    prop 1    prop 2
## 0.4141414 0.4574468
##
## [1] "eq_problem8"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.0000000000000000000000000000019337, df = 1, p-value
## = 1
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.1284465  0.1228587
## sample estimates:
##    prop 1    prop 2
## 0.2525253 0.2553191
##
```

```
## [1] "eq_problem9"
##
##  2-sample test for equality of proportions with continuity
##  correction
##
## data:  c(metatutorc_sums[i], metatutormc_sums[i]) out of c(metatutorc_count, metatutormc_count)
## X-squared = 0.17962, df = 1, p-value = 0.6717
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.09848493  0.17370521
## sample estimates:
##    prop 1    prop 2
## 0.2929293 0.2553191
```

We can see that none of the Chi-square test gives a p-value below 5%. By visually inspecting the Likert plots we can also deduce that there are no obvious differences between the conditions as we expected because these are pre-treament data.

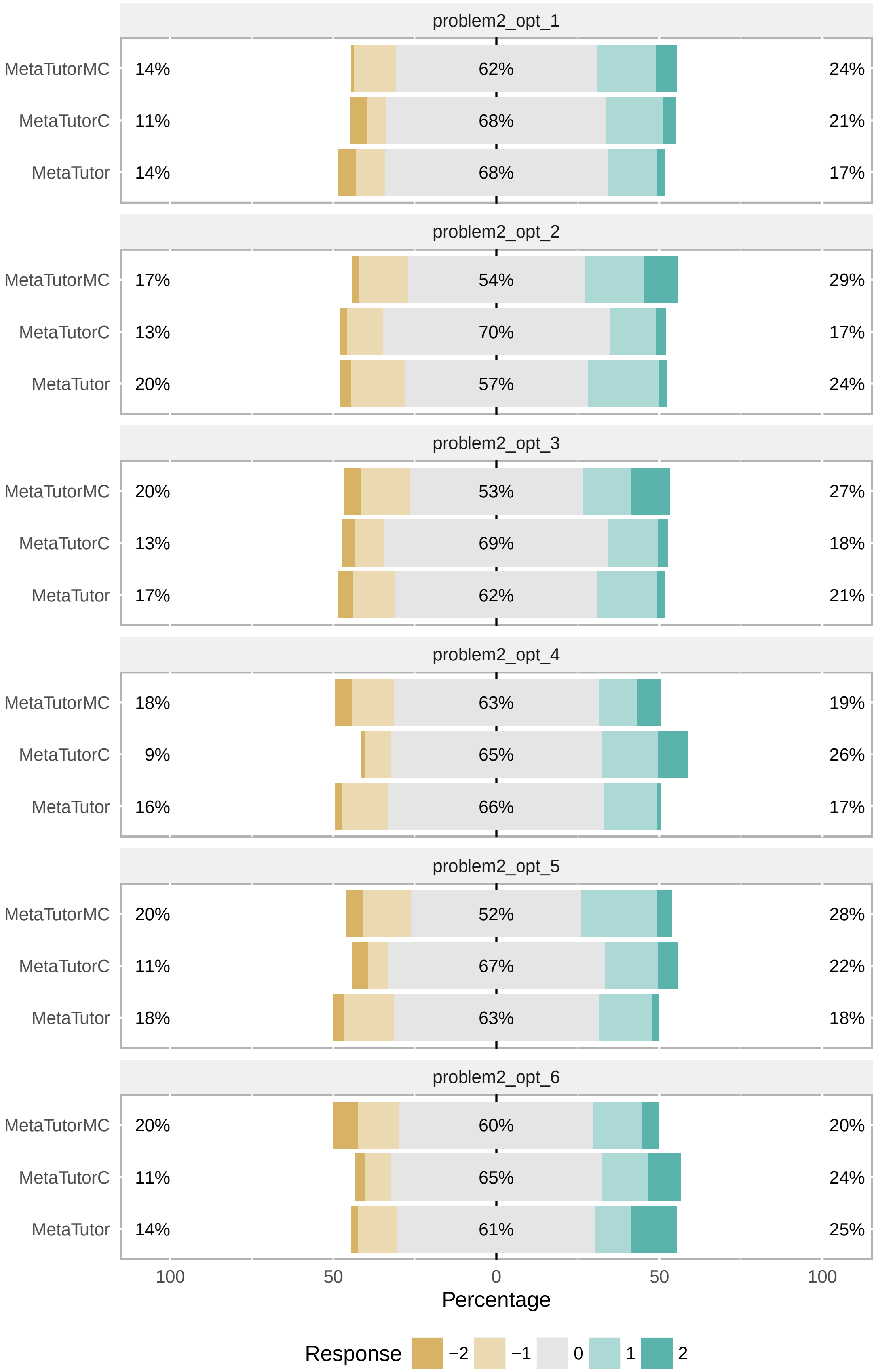
Step 6 - Calculate, show and assess the effect of the conditions

One way to show the effects of the different conditions is to calculate the "shift", that is, the difference between the post- and the pre-test. Hence we can measure the effect of the treatment. Also this shift can be represented by Likert plots.



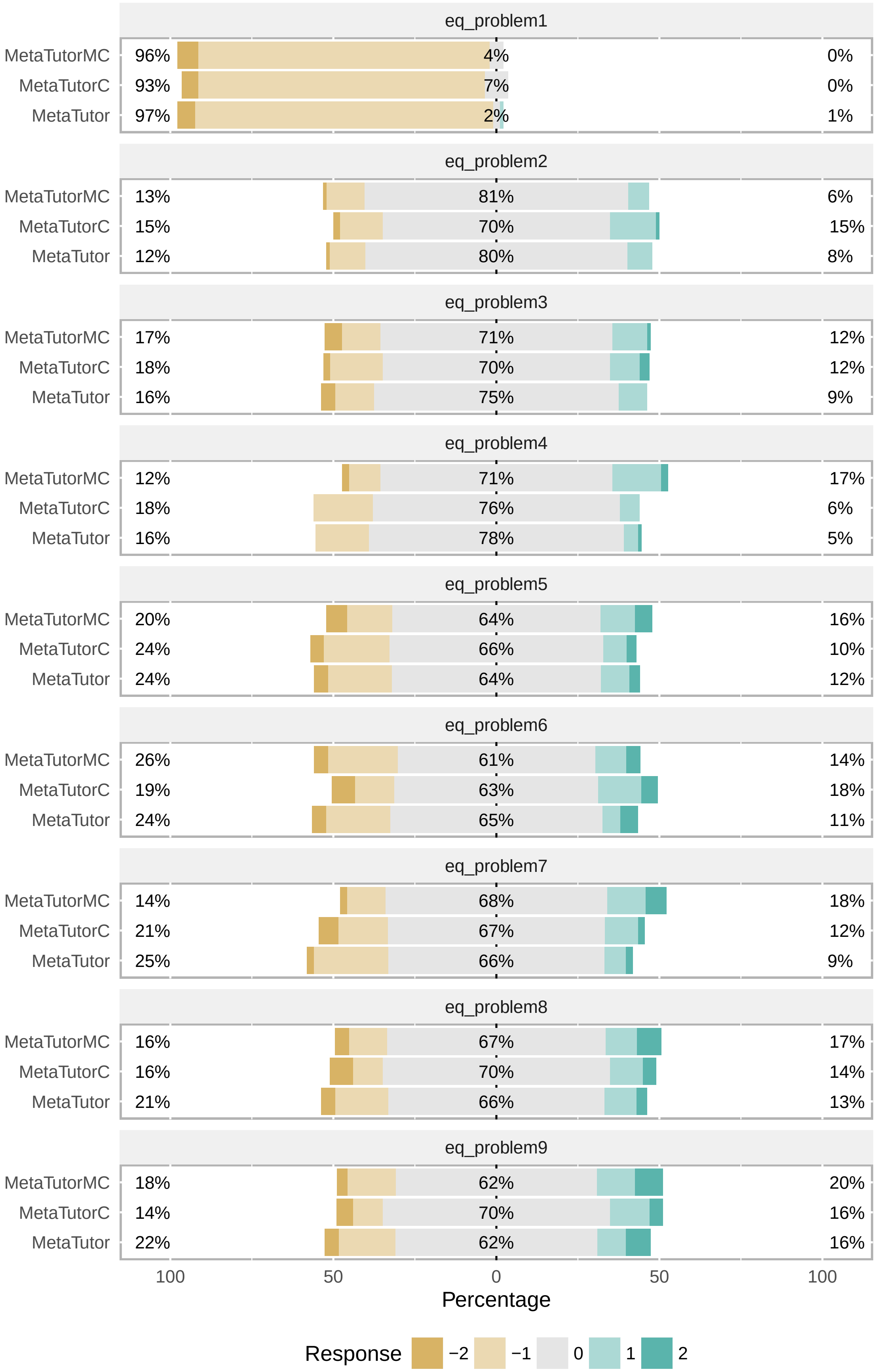
problem1_opt_1
MetaTutorMC 15% 69% 16%
MetaTutorC 11% 64% 25%
MetaTutor 15% 70% 15%
problem1_opt_2
MetaTutorMC 11% 74% 15%
MetaTutorC 15% 68% 17%
MetaTutor 12% 74% 14%
problem1_opt_3
MetaTutorMC 15% 63% 22%
MetaTutorC 16% 59% 25%
MetaTutor 15% 68% 16%
problem1_opt_4
MetaTutorMC 16% 61% 23%
MetaTutorC 17% 51% 32%
MetaTutor 16% 65% 18%
problem1_opt_5
MetaTutorMC 23% 52% 24%
MetaTutorC 15% 57% 28%
MetaTutor 16% 54% 29%
problem1_opt_6
MetaTutorMC 15% 65% 20%
MetaTutorC 18% 60% 22%
MetaTutor 16% 62% 22%
100 50 0 50 100
Percentage
Response −2 −1 0 1 2

```
## Saving 6.5 x 6 in image
```



problem2_opt_1
MetaTutorMC 14% 62% 24%
MetaTutorC 11% 68% 21%
MetaTutor 14% 68% 17%
problem2_opt_2
MetaTutorMC 17% 54% 29%
MetaTutorC 13% 70% 17%
MetaTutor 20% 57% 24%
problem2_opt_3
MetaTutorMC 20% 53% 27%
MetaTutorC 13% 69% 18%
MetaTutor 17% 62% 21%
problem2_opt_4
MetaTutorMC 18% 63% 19%
MetaTutorC 9% 65% 26%
MetaTutor 16% 66% 17%
problem2_opt_5
MetaTutorMC 20% 52% 28%
MetaTutorC 11% 67% 22%
MetaTutor 18% 63% 18%
problem2_opt_6
MetaTutorMC 20% 60% 20%
MetaTutorC 11% 65% 24%
MetaTutor 14% 61% 25%
100 50 0 50 100
Percentage
Response −2 −1 0 1 2

```
## Saving 6.5 x 6 in image
```


eq_problem1
MetaTutorMC 96% 4% 0%
MetaTutorC 93% 7% 0%
MetaTutor 97% 2% 1%
eq_problem2
MetaTutorMC 13% 81% 6%
MetaTutorC 15% 70% 15%
MetaTutor 12% 80% 8%
eq_problem3
MetaTutorMC 17% 71% 12%
MetaTutorC 18% 70% 12%
MetaTutor 16% 75% 9%
eq_problem4
MetaTutorMC 12% 71% 17%
MetaTutorC 18% 76% 6%
MetaTutor 16% 78% 5%
eq_problem5
MetaTutorMC 20% 64% 16%
MetaTutorC 24% 66% 10%
MetaTutor 24% 64% 12%
eq_problem6
MetaTutorMC 26% 61% 14%
MetaTutorC 19% 63% 18%
MetaTutor 24% 65% 11%
eq_problem7
MetaTutorMC 14% 68% 18%
MetaTutorC 21% 67% 12%
MetaTutor 25% 66% 9%
eq_problem8
MetaTutorMC 16% 67% 17%
MetaTutorC 16% 70% 14%
MetaTutor 21% 66% 13%
eq_problem9
MetaTutorMC 18% 62% 20%
MetaTutorC 14% 70% 16%
MetaTutor 22% 62% 16%
100 50 0 50 100
Percentage
Response −2 −1 0 1 2

```
## Saving 6.5 x 9 in image
```