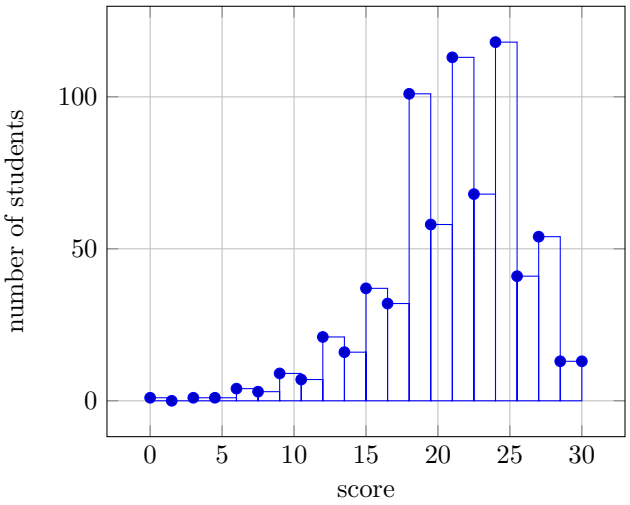
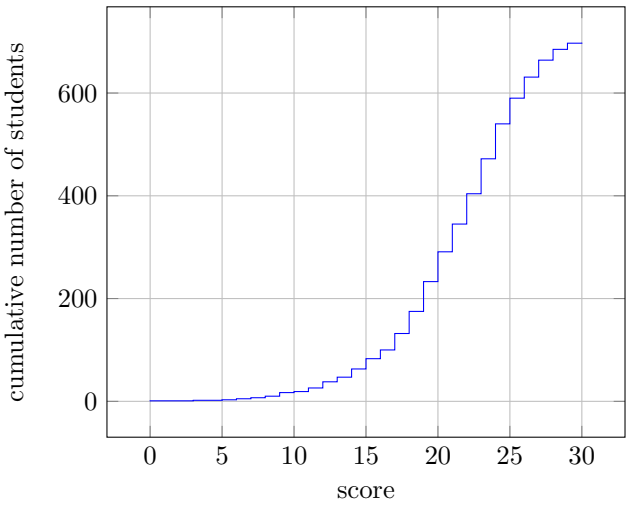
CS 101 Midterm #1, Fall 2016: Statistics

1 Student score distribution

number of students	698	
minimum score	0	0.0%
maximum score	30	100.0%
mean score	20.9971	70.0%
median score	22	73.3%
std. dev.	4.60783	15.4%
num. perfect scores	1	0.1%

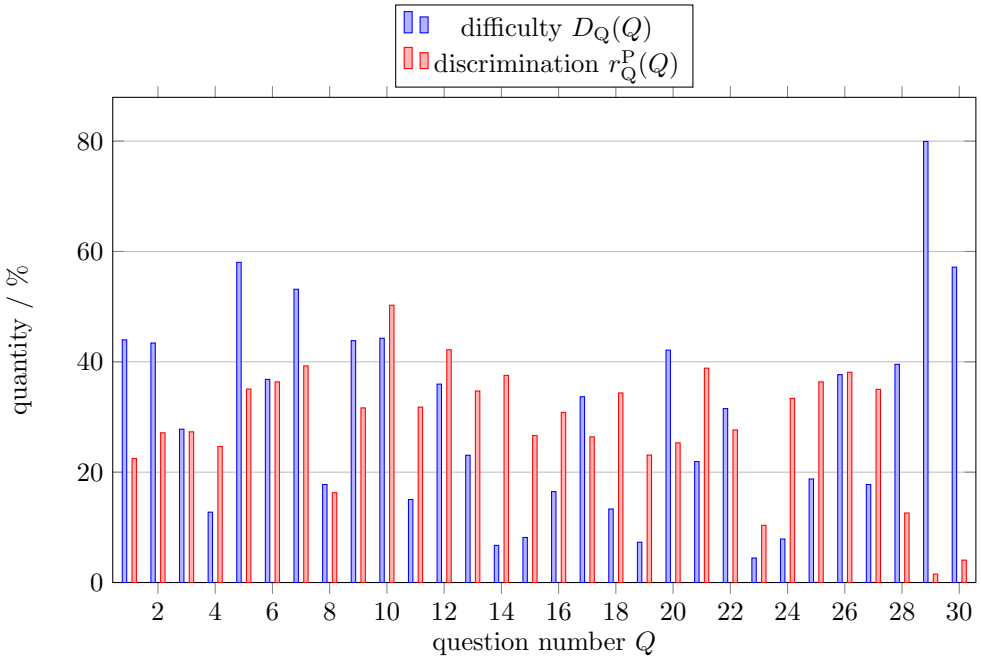




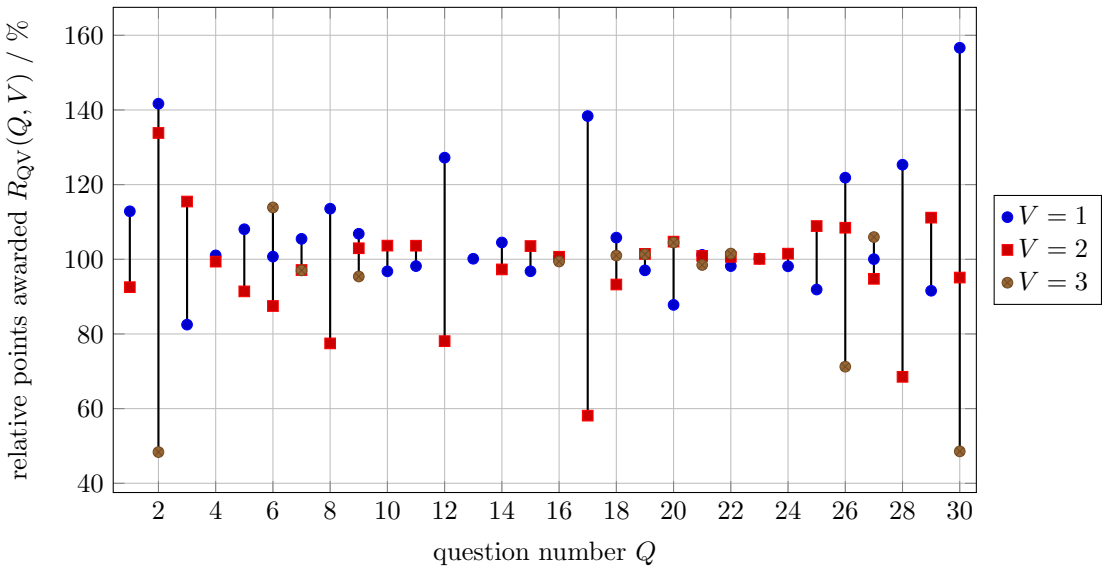
2 Question summary data

The plot below shows the *difficulty* and *discrimination* for each question. Ideally the discrimination should be high, and there should be a mixture of easy and hard questions.

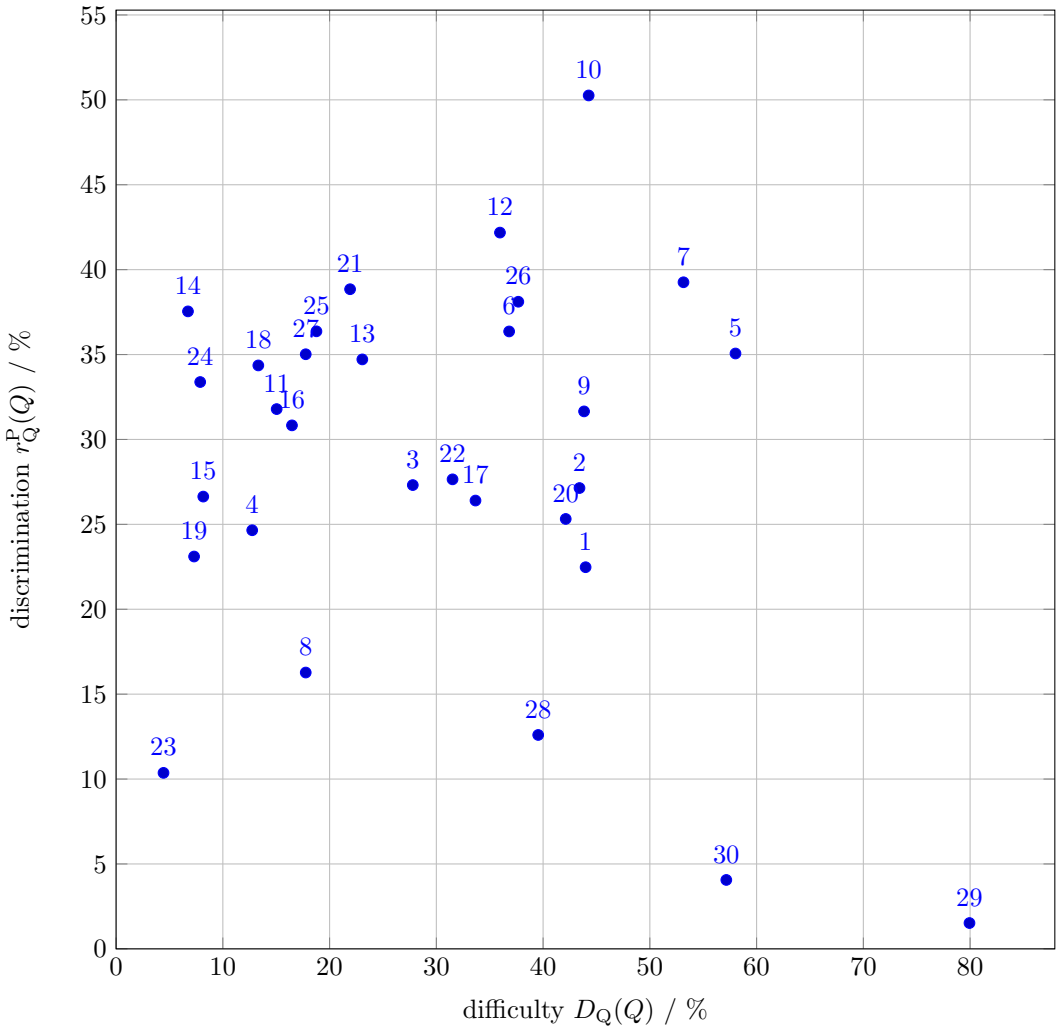
quantity	symbol	description
difficulty	$D_{\mathrm{Q}}(Q)$	fraction of students who get question Q incorrect
discrimination	$r^{\mathrm{P}}_{\mathrm{Q}}(Q)$	correlation of scores between question Q and the total exam



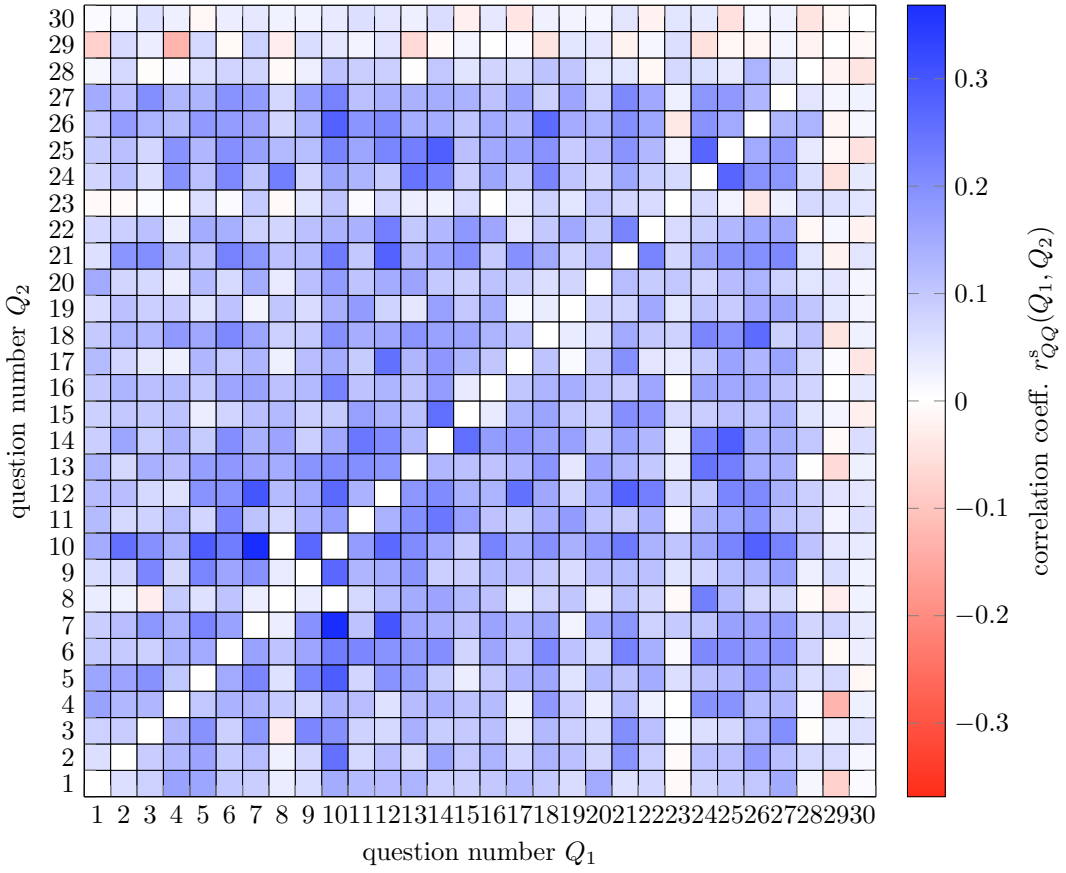
The following plot shows the relative points for the question variants. Variants with $R_{\mathrm{QV}}(Q,V)$ above 100% are easier than average (more points awarded), while values below 100% indicate a harder-than-average variant.



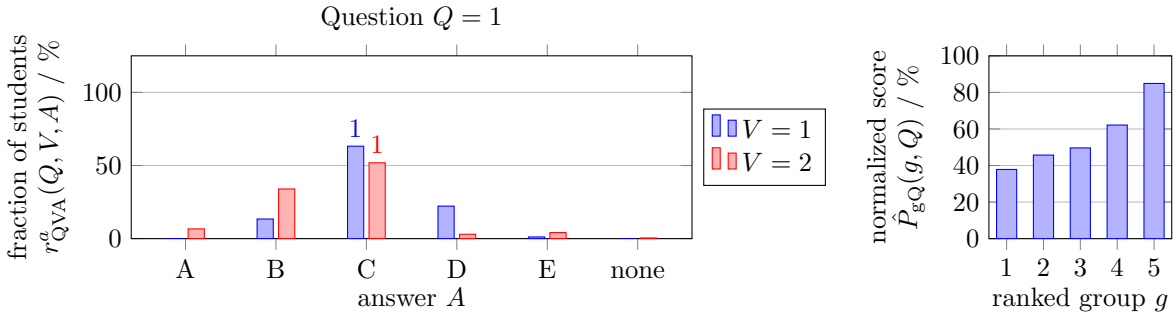
The scatter-plot below contains the same information as the first plot in this section, but plots the *discrimination* against the *difficulty* for each question. Questions should ideally be high on this plot (discriminating well), and there should be a mixture of left-to-right (difficulty) values.

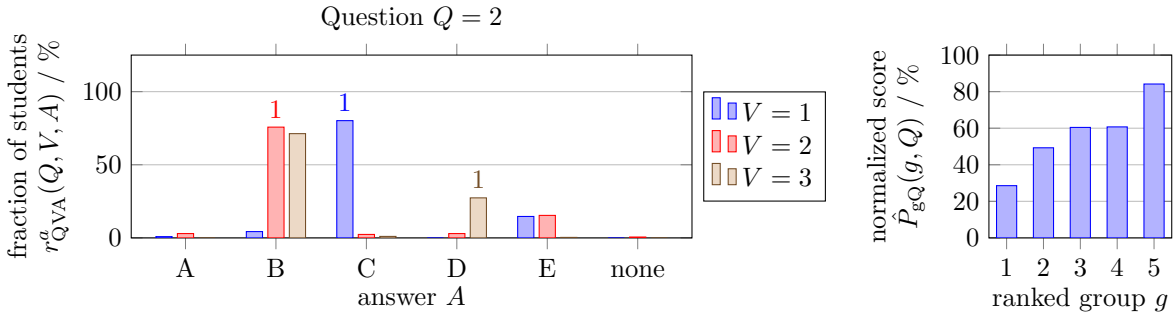


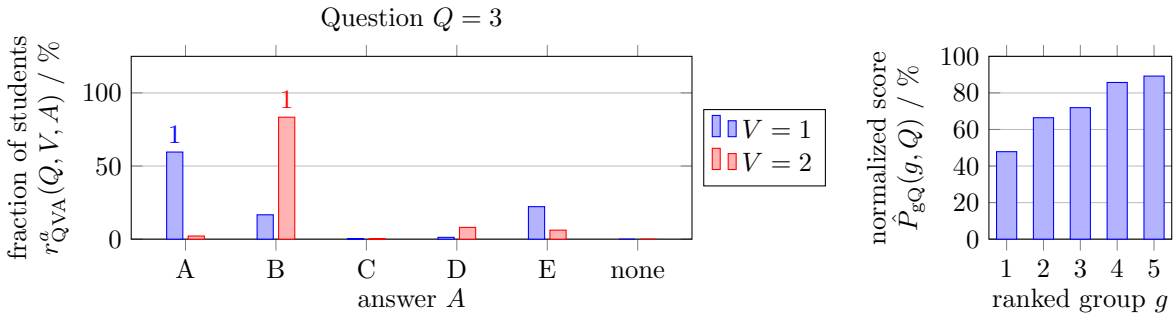
The plot below shows the correlation coefficient $r^{\mathrm{s}}_{\mathrm{QQ}}$ of student scores on different questions. Positive correlations are shown in red colors, and negative correlations in blue. Gray color indicates uncorrelated questions. Each question correlates perfectly with itself ($r = 1$), but self-correlations are plotted as $r = 0$ to improve the colorbar range.

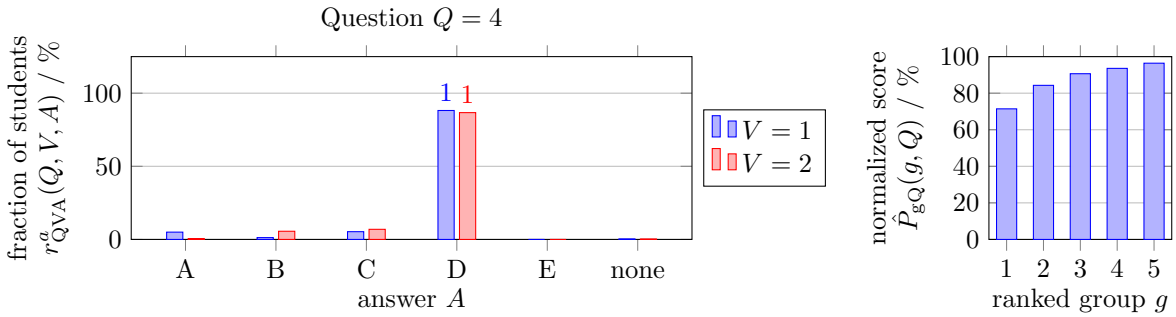


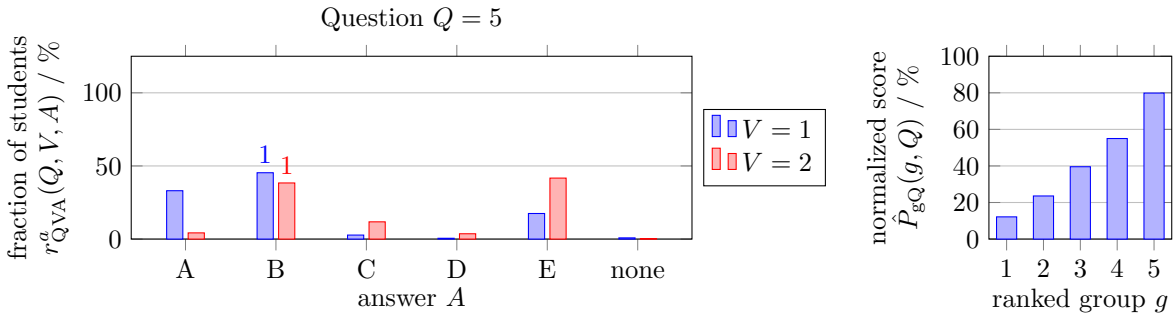
3 Question detailed data

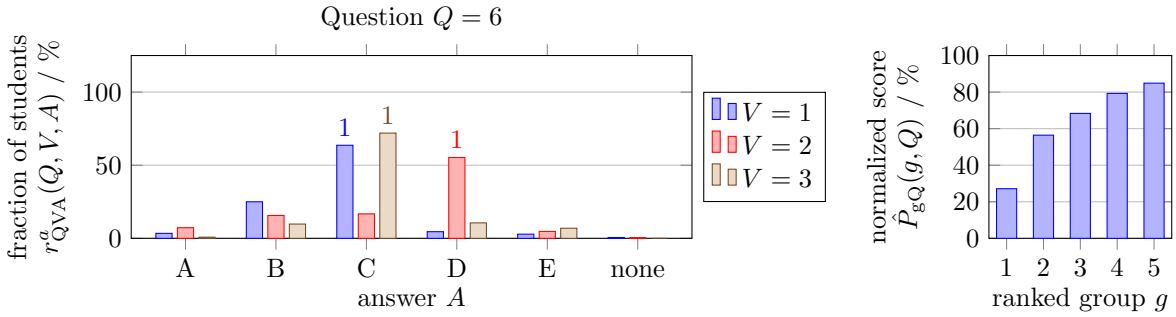


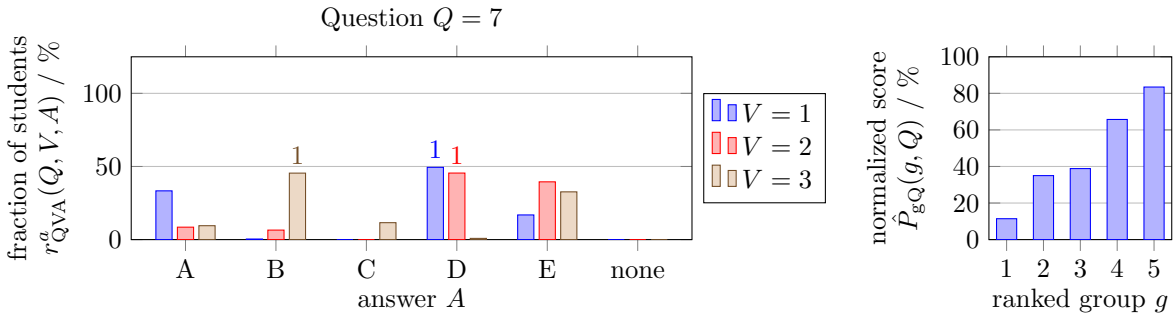


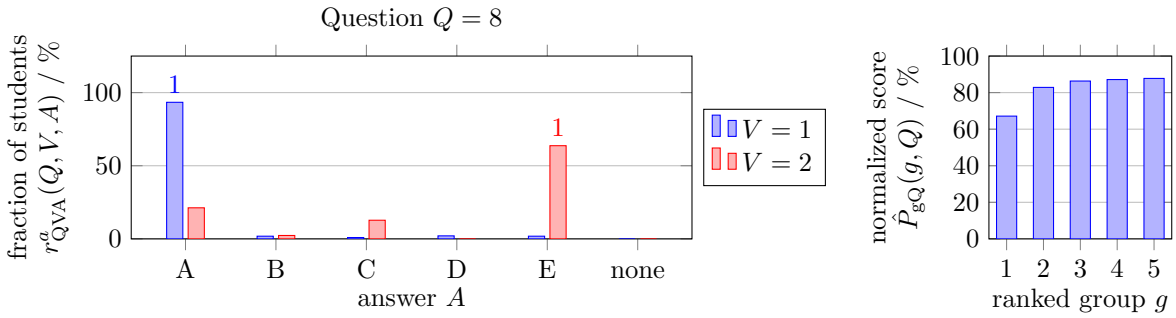


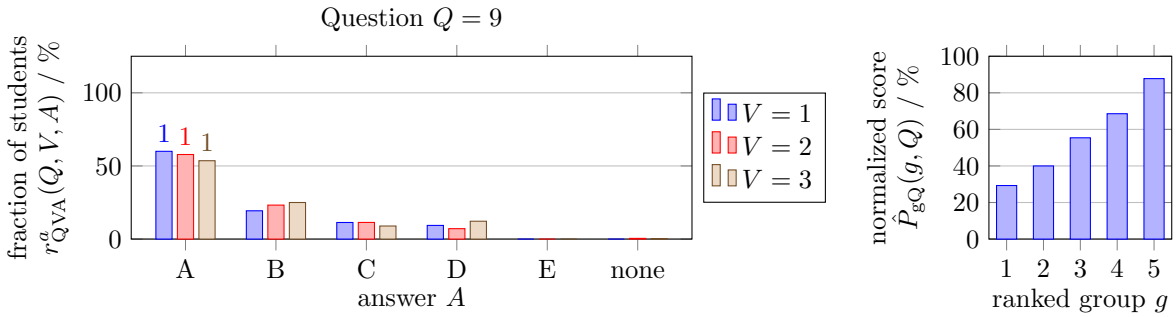


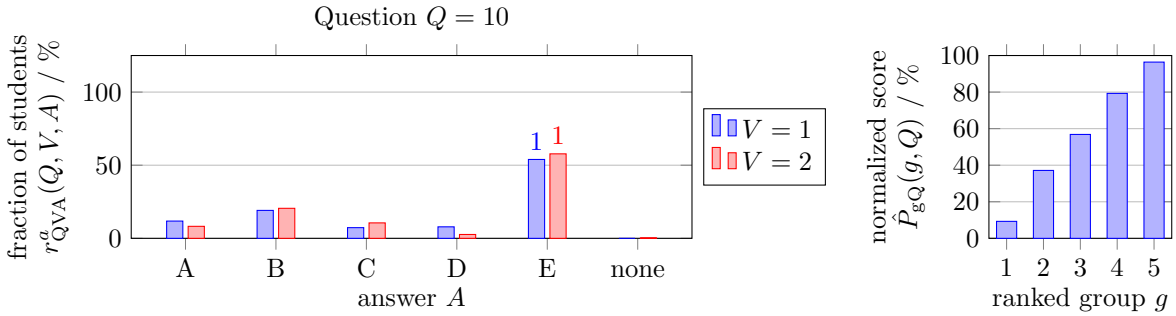

Question $Q = 5$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

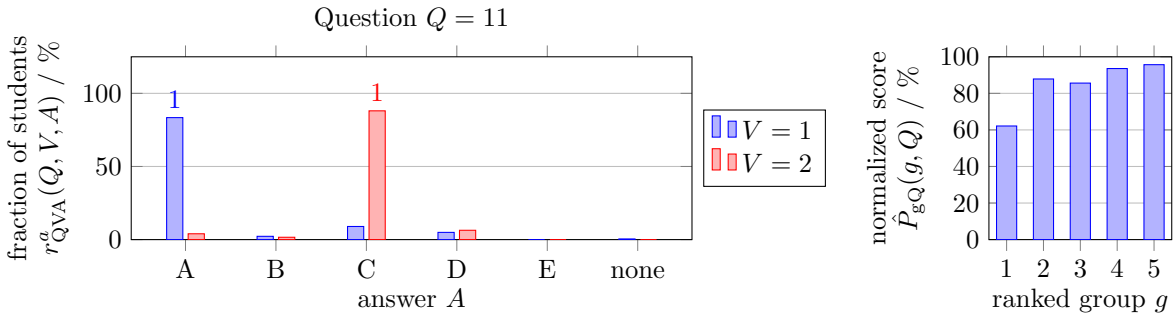

Question $Q = 6$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
$V = 3$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

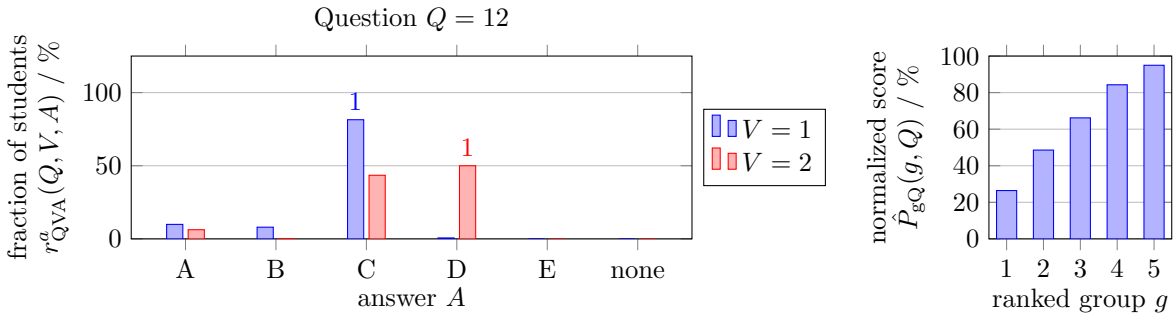

Question $Q = 7$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
$V = 3$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

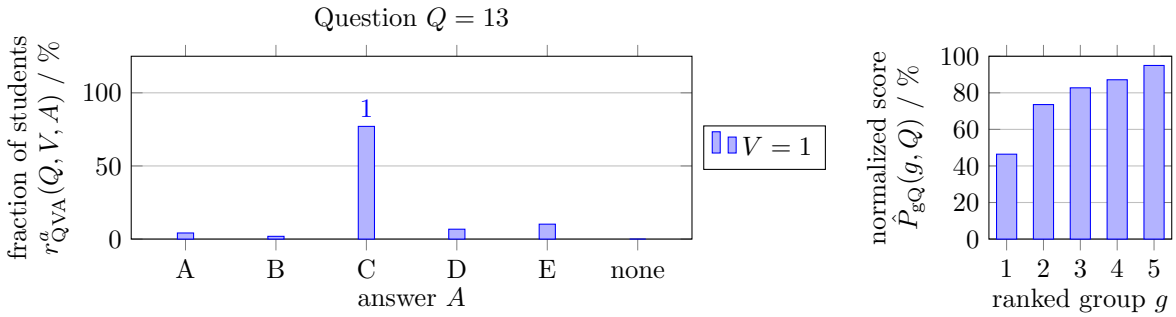

Question $Q = 8$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

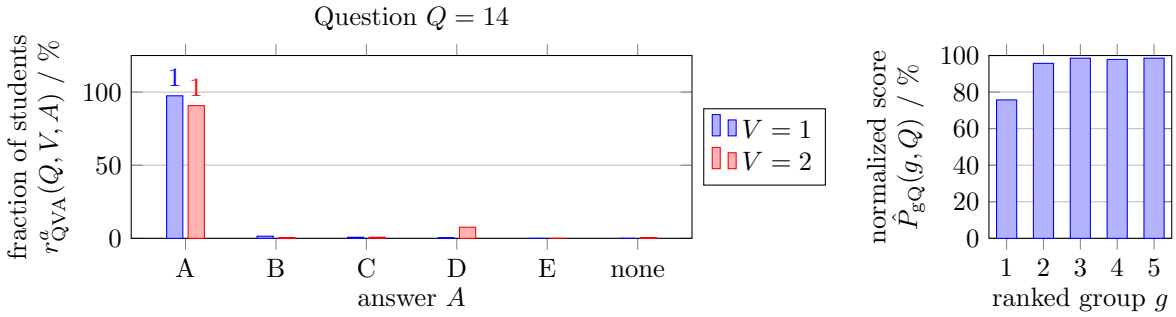

Question $Q = 9$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1 1 1
A B C D E none
answer A
$V = 1$
$V = 2$
$V = 3$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100 80 60 40 20 0
1 2 3 4 5
ranked group g

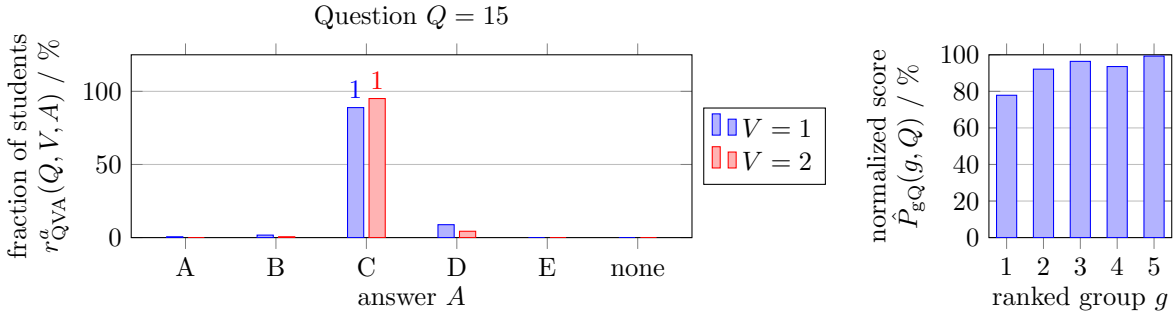

Question $Q = 10$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1 1
A B C D E none
answer A
$V = 1$
$V = 2$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100 80 60 40 20 0
1 2 3 4 5
ranked group g

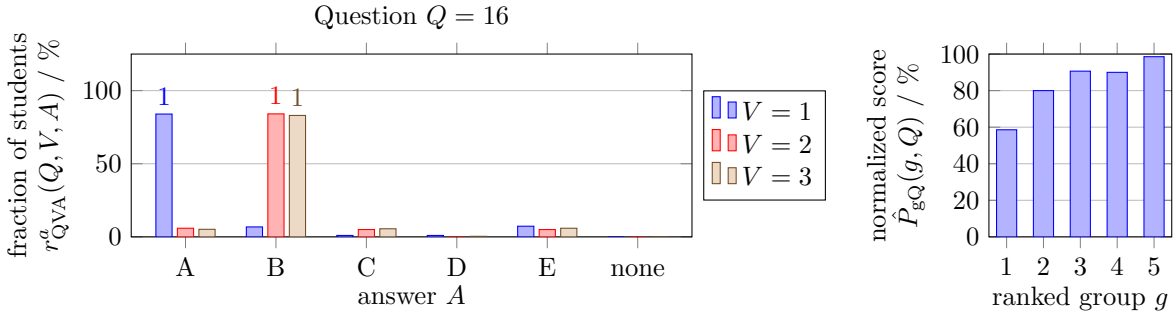

Question $Q = 11$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1 1
A B C D E none
answer A
$V = 1$
$V = 2$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100 80 60 40 20 0
1 2 3 4 5
ranked group g

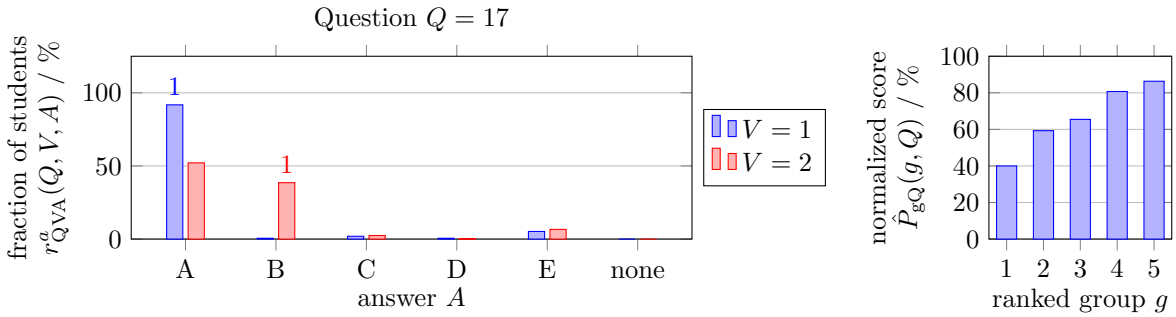

Question $Q = 12$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1 1
A B C D E none
answer A
$V = 1$
$V = 2$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100 80 60 40 20 0
1 2 3 4 5
ranked group g

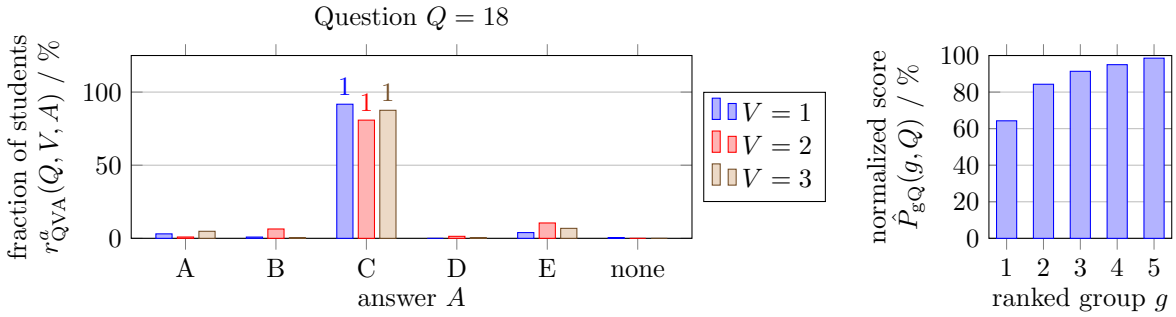

Question $Q = 13$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
A
B
C
D
E
none
answer A
$V = 1$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

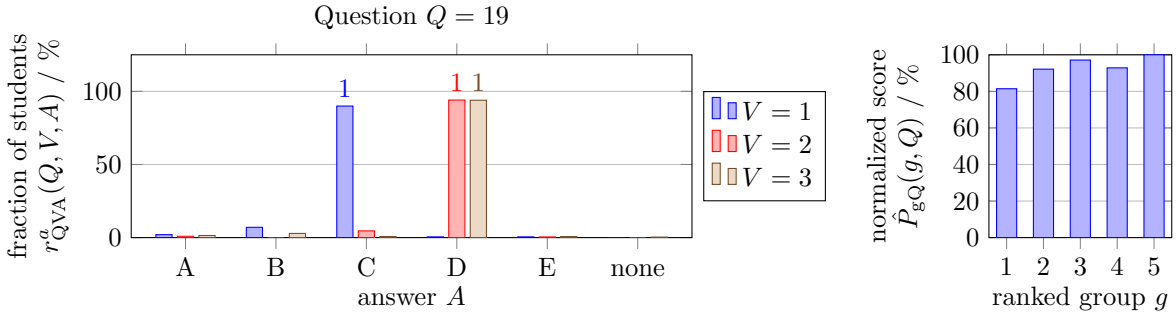

Question $Q = 14$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1 1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

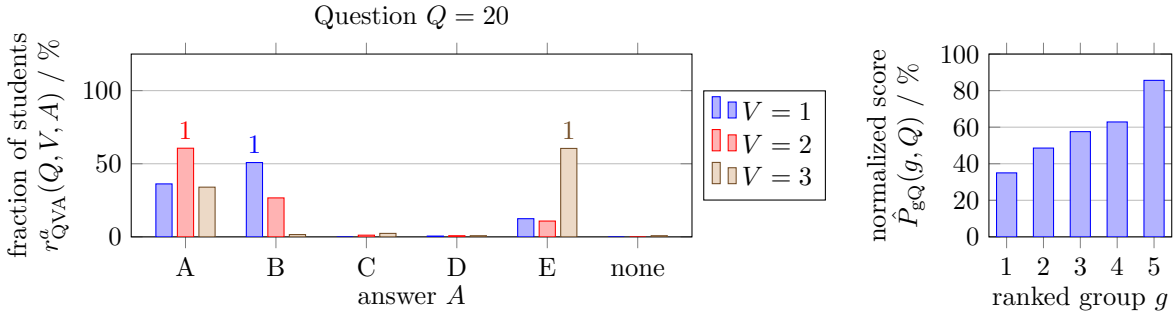

Question $Q = 15$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1 1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

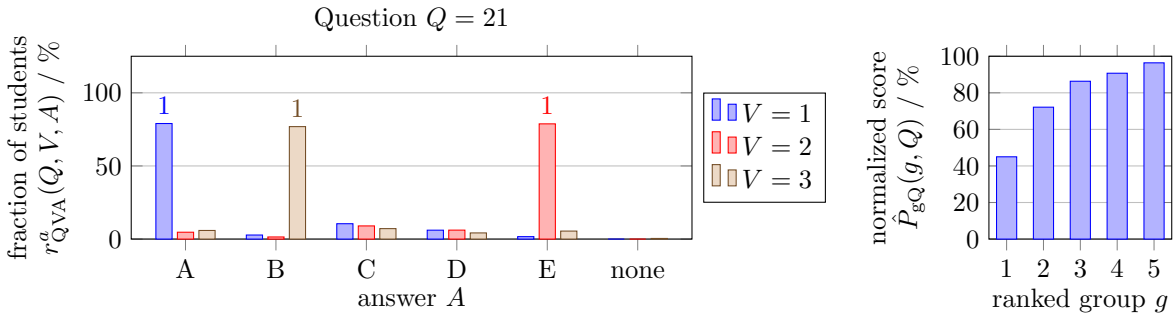

Question $Q = 16$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1 1 1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
$V = 3$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

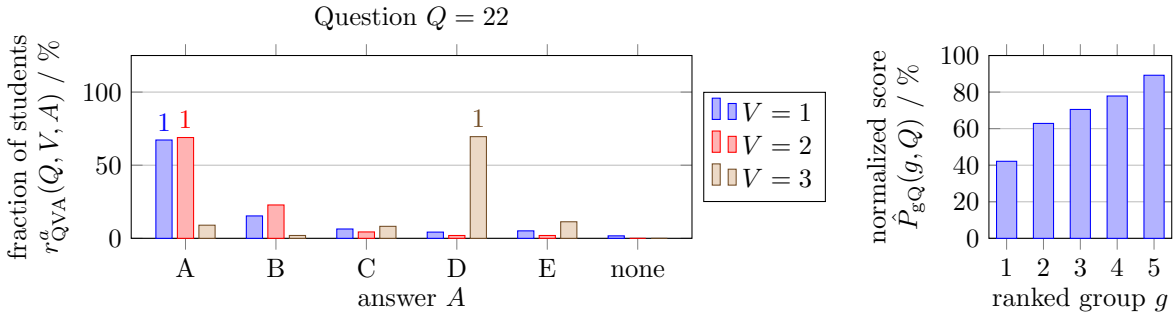

Question $Q = 17$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

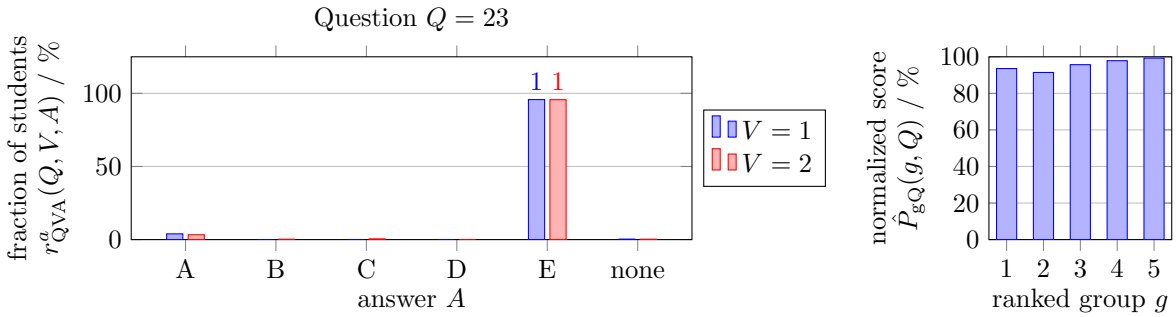

Question $Q = 18$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
$V = 3$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

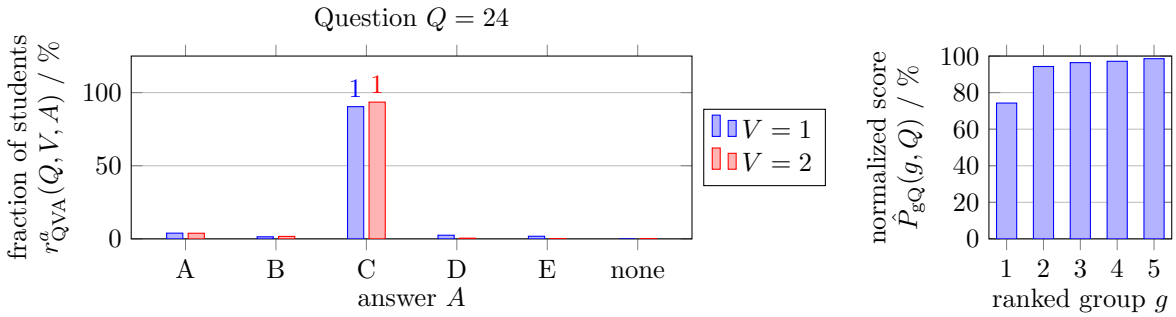

Question $Q = 19$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
$V = 3$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

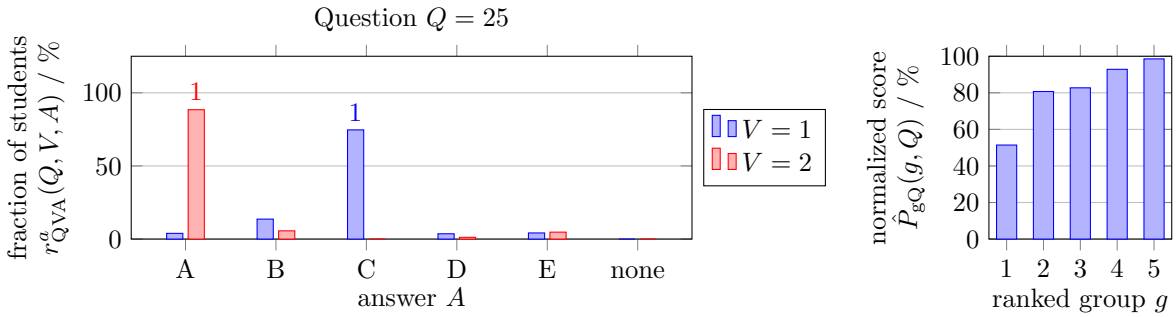

Question $Q = 20$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
$V = 3$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

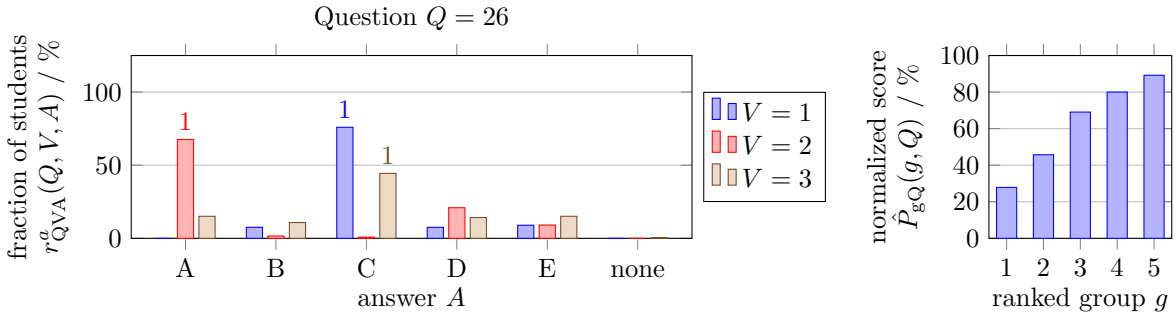

Question $Q = 21$
fraction of students $r^a_{\mathrm{QVA}}(Q,V,A)$ / %
100
50
0
1
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
$V = 3$
normalized score $\hat{P}_{\mathrm{gQ}}(g,Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

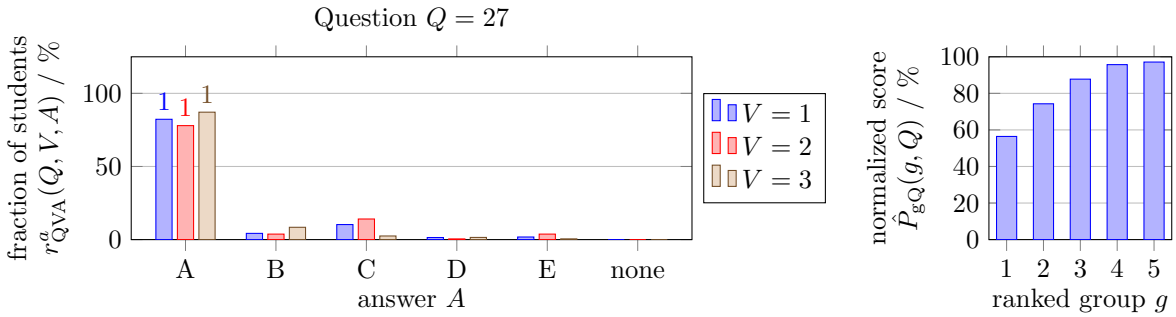

Question $Q = 22$
fraction of students $r^a_{\mathrm{QVA}}(Q,V,A)$ / %
100
50
0
1 1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
$V = 3$
normalized score $\hat{P}_{\mathrm{gQ}}(g,Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

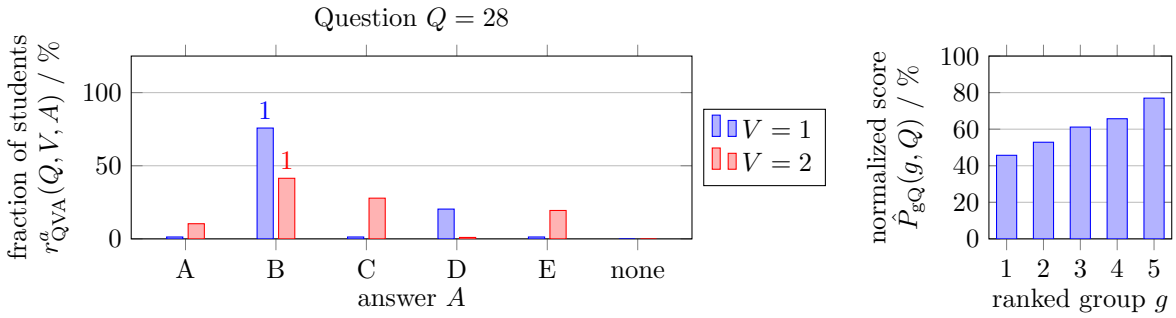

Question $Q = 23$
fraction of students $r^a_{\mathrm{QVA}}(Q,V,A)$ / %
100
50
0
1 1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
normalized score $\hat{P}_{\mathrm{gQ}}(g,Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

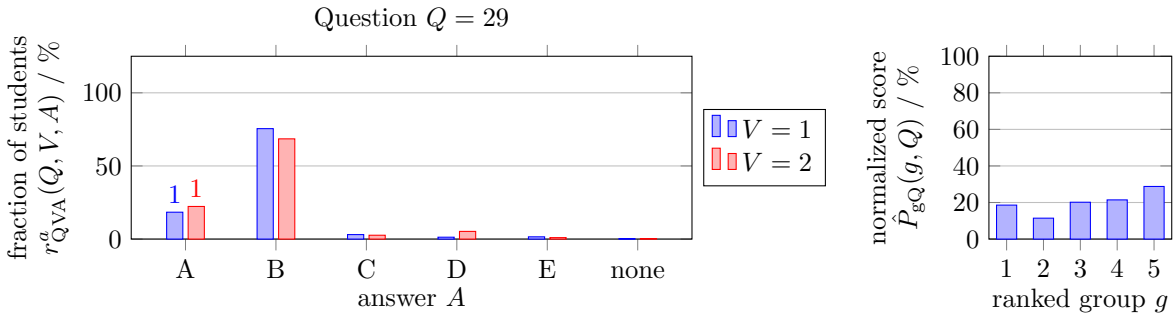

Question $Q = 24$
fraction of students $r^a_{\mathrm{QVA}}(Q,V,A)$ / %
100
50
0
1 1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
normalized score $\hat{P}_{\mathrm{gQ}}(g,Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g

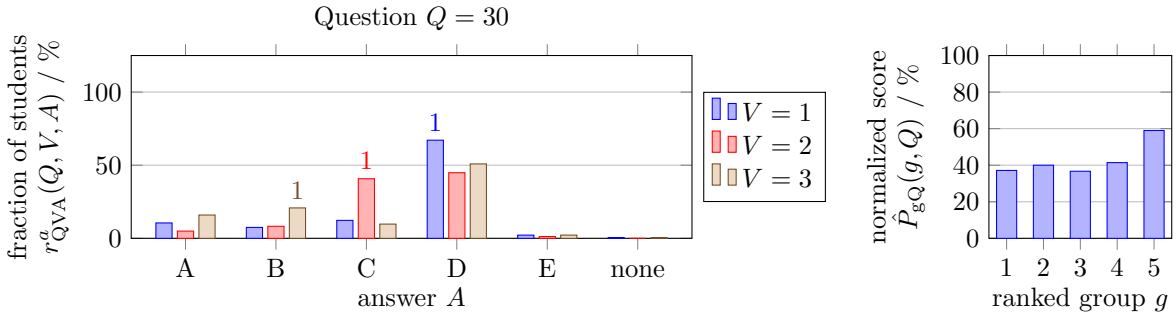

Question $Q = 25$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g


Question $Q = 26$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
$V = 3$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g


Question $Q = 27$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
$V = 3$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g


Question $Q = 28$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g


Question $Q = 29$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g


Question $Q = 30$
fraction of students $r^a_{\mathrm{QVA}}(Q, V, A)$ / %
100
50
0
1
1
1
A
B
C
D
E
none
answer A
$V = 1$
$V = 2$
$V = 3$
normalized score $\hat{P}_{\mathrm{gQ}}(g, Q)$ / %
100
80
60
40
20
0
1 2 3 4 5
ranked group g