Rasch modeling - part II

Rasch modeling in R

Intro

Today's goal:

How to run a Rasch model in R

Outline:

- Item stats
- Person stats
- Item-person plots and kidmaps

Data

Dissertation data: disclosure of demographics items to a health or energy recommender system

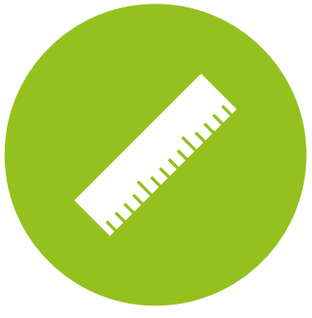
- 57 demographic items used in study 1
- Note: not every user disclosed all items! (lots of missing data)

Data

1. What is your favorite hobby?
2. What is your current type of employment?
3. How much do you read?
4. How often do you ride your bike?
5. How much do you weigh?
6. How often do you use public transportation?
7. Who do you vote for?
8. Do you or your partner use any type of birth control?
9. In the last 3 months, how many times have you been cited for traffic violations?
10. Do you eat organic food?
11. What is your field of work?
12. How many sexual partners have you had so far?
13. Are you active in a sports competition?
14. What is your education?
15. What is your amount of savings?
16. How much are you in debt?
17. What kind of car do you own?
18. What is your current mobile data plan?
19. In what type of area do you live?
20. What kind of toilet paper do you use?
21. What is your height?
22. Are you vegetarian?
23. What is your relationship status?
24. Do you ever regret your eating behavior?
25. What is your household income?
26. What is your age?
27. Are you a member of an environmental organization?
28. Do you ever download movies illegally?
29. What is your gender?
30. What is your housing situation?
31. What is your monthly energy bill?
32. What is your favorite genre of music?
33. How often do you watch pornography?
34. Do you have children?
35. Are you on a diet?
36. What is your most practiced sport?
37. In what size do you typically buy your beverages?
38. How often do you have sex?
39. What is your religion?
40. Do you carpool?
41. Which social services do you use?
42. Do you have a criminal record?
43. How often do you work out?
44. What is your race?
45. How frequently do you use the computer?
46. Do you separate your household trash?
47. Have you ever cheated in a relationship?
48. What is your phone's voice and text plan?
49. Do you have a gym membership?
50. In which news category are you most interested?
51. What is your sexual orientation?
52. How often do you eat fast food?
53. How long do you usually shower?
54. Do you have any of the following medical conditions?
55. How frequently do you watch TV?
56. Which of the following charities do you financially support?
57. Have you ever been evicted?

Item stats

Running the model and getting item statistics



Run the model

Install TAM package

Run the model:

```
mod <- tam(dem, constraint="items")
```

Item stats

mod$xsi has the difficulties

For item fit, you have to run tam.fit(mod)

Merge item difficulty and fit stats:

```
itemfit <- cbind(mod$xsi,tam.fit(mod)$itemfit[c(2:3,6:7)])
```

Print:

```
itemfit[order(-itemfit$xsi),]
```

Plot

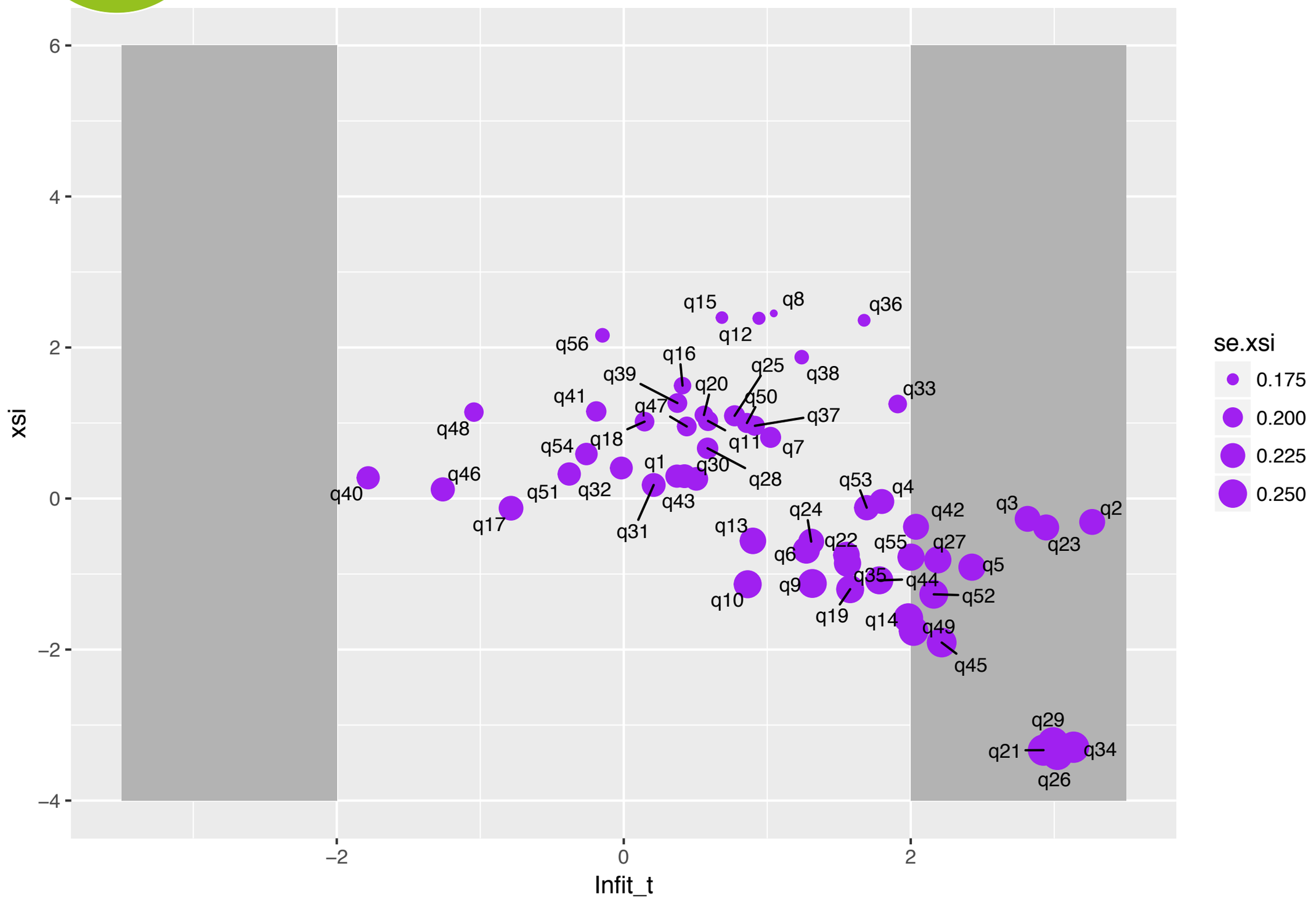
Install ggplot2, ggrepel

Item pathway:

Plot, x-limits, rectangles indicating misfit, bubbles, labels

```
ggplot(itemfit,aes(Infit_t,xsi))+ xlim(-3.5,3.5)+
geom_rect(aes(xmin=-3.5,xmax=-2,ymin=-4,ymax=6),fill="grey70")+
geom_rect(aes(xmin=2,xmax=3.5,ymin=-4,ymax=6),fill="grey70")+
geom_point(aes(size=se.xsi),color="purple")+
geom_text_repel(aes(label=label),size=3)
```

Plot


6
4
2
0
−2
−4
xsi
−2
0
2
Infit_t
se.xsi
0.175
0.200
0.225
0.250
q56
q15
q8
q36
q12
q16
q25
q38
q39
q20
q33
q41
q47
q50
q37
q48
q18
q11
q7
q54
q1
q30
q28
q40
q46
q51
q32
q43
q53
q4
q17
q31
q24
q42
q3
q2
q13
q22
q55
q27
q23
q6
q5
q35
q44
q9
q52
q10
q19
q14
q49
q45
q29
q21
q34
q26

Summary

Install pastecs

Summary:

round(stat.desc(itemfit,basic=F),4)

	xsi	se.xsi	Outfit	Outfit_t	Infit	Infit_t
median	0.1501	0.2199	0.9220	0.2619	1.0904	1.0344
mean	-0.0095	0.2217	0.9745	0.3544	1.1160	1.1347
SE.mean	0.1920	0.0037	0.0263	0.1282	0.0164	0.1548
CI.mean.0.95	0.3848	0.0074	0.0527	0.2569	0.0330	0.3101
var	2.0646	0.0008	0.0387	0.9205	0.0152	1.3411
std.dev	1.4369	0.0276	0.1967	0.9594	0.1231	1.1580
coef.var	-150.5932	0.1243	0.2019	2.7070	0.1103	1.0205

Person stats

Running the model again* and getting person statistics

Person stats

Install sirt package

Person abilities are in mod$person

Person fit stats:

```
pfit <- pcm.fit(b=-mod$AXsi[,-1], theta=tam.wle(mod)
$theta, dem)
```

Merge person abilities and fit stats:

```
personfit <- cbind(mod$person,pfit$personfit[c(2:5)])
personfit
```

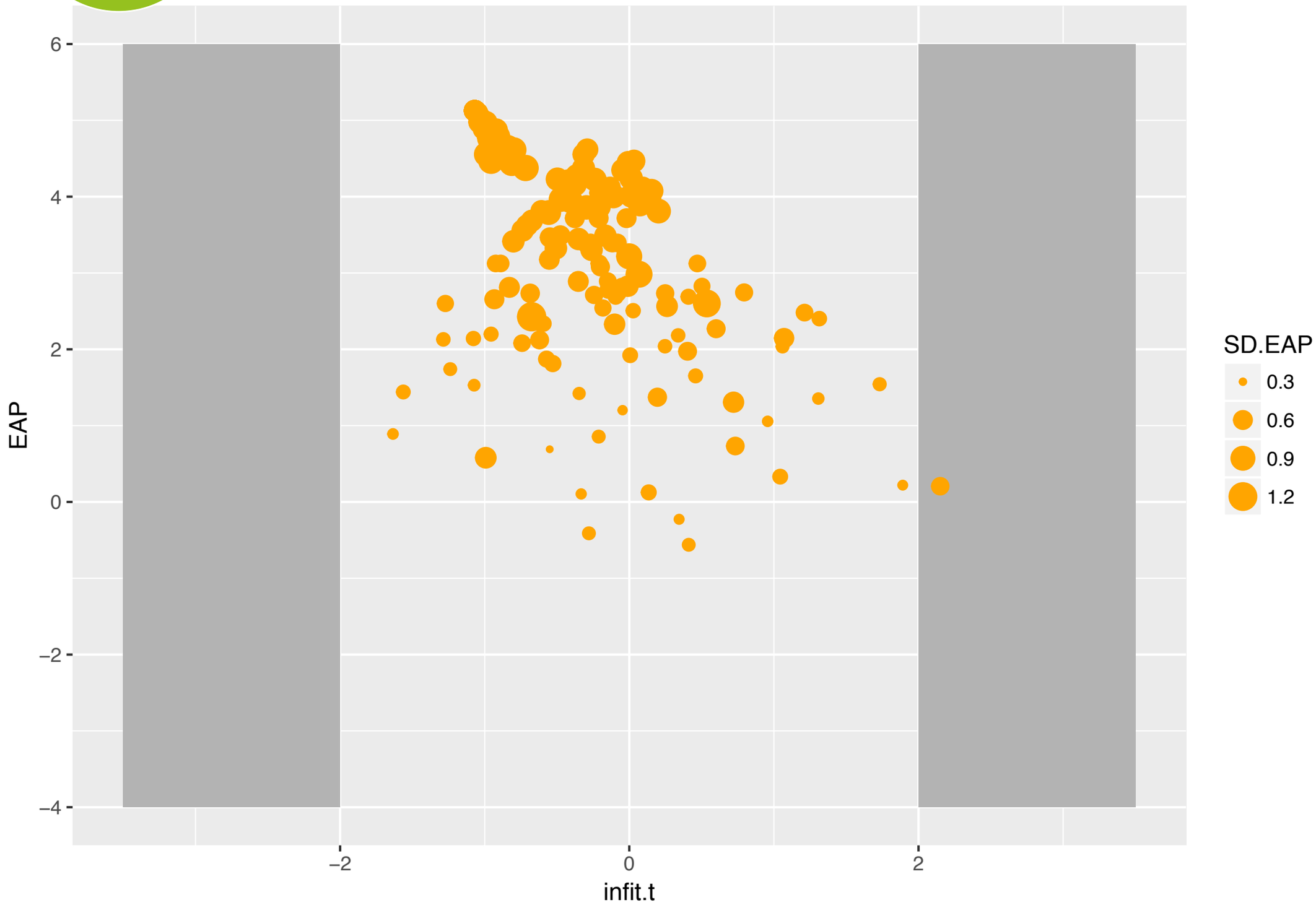
Plot

Person pathway:

Plot, x-limits, rectangles indicating misfit, bubbles

```
ggplot(personfit,aes(infit.t,EAP))+ xlim(-3.5,3.5)+
geom_rect(aes(xmin=-3.5,xmax=-2,ymin=-4,ymax=6),fill="grey70")
+geom_rect(aes(xmin=2,xmax=3.5,ymin=-4,ymax=6),fill="grey70")
+geom_point(aes(size=SD.EAP),color="orange")
```

Plot



Summary

Install pastecs

Summary:

round(stat.desc(personfit[6:11],basic=F),4)

	EAP	SD.EAP	outfit	outfit.t	infit	infit.t
median	3.9880	0.6833	0.3182	0.3909	0.6955	-0.6239
mean	3.6399	0.6630	0.5047	0.3216	0.5466	-0.4766
SE.mean	0.1009	0.0130	0.0560	0.0439	0.0311	0.0467
CI.mean.0.95	0.1990	0.0255	0.1104	0.0866	0.0614	0.0920
var	2.0976	0.0346	0.6394	0.3935	0.1977	0.4444
std.dev	1.4483	0.1860	0.7996	0.6273	0.4446	0.6666
coef.var	0.3979	0.2805	1.5843	1.9503	0.8134	-1.3986

Additional plots

Item-person plot, item-person pathway, kidmaps

Item-person plot

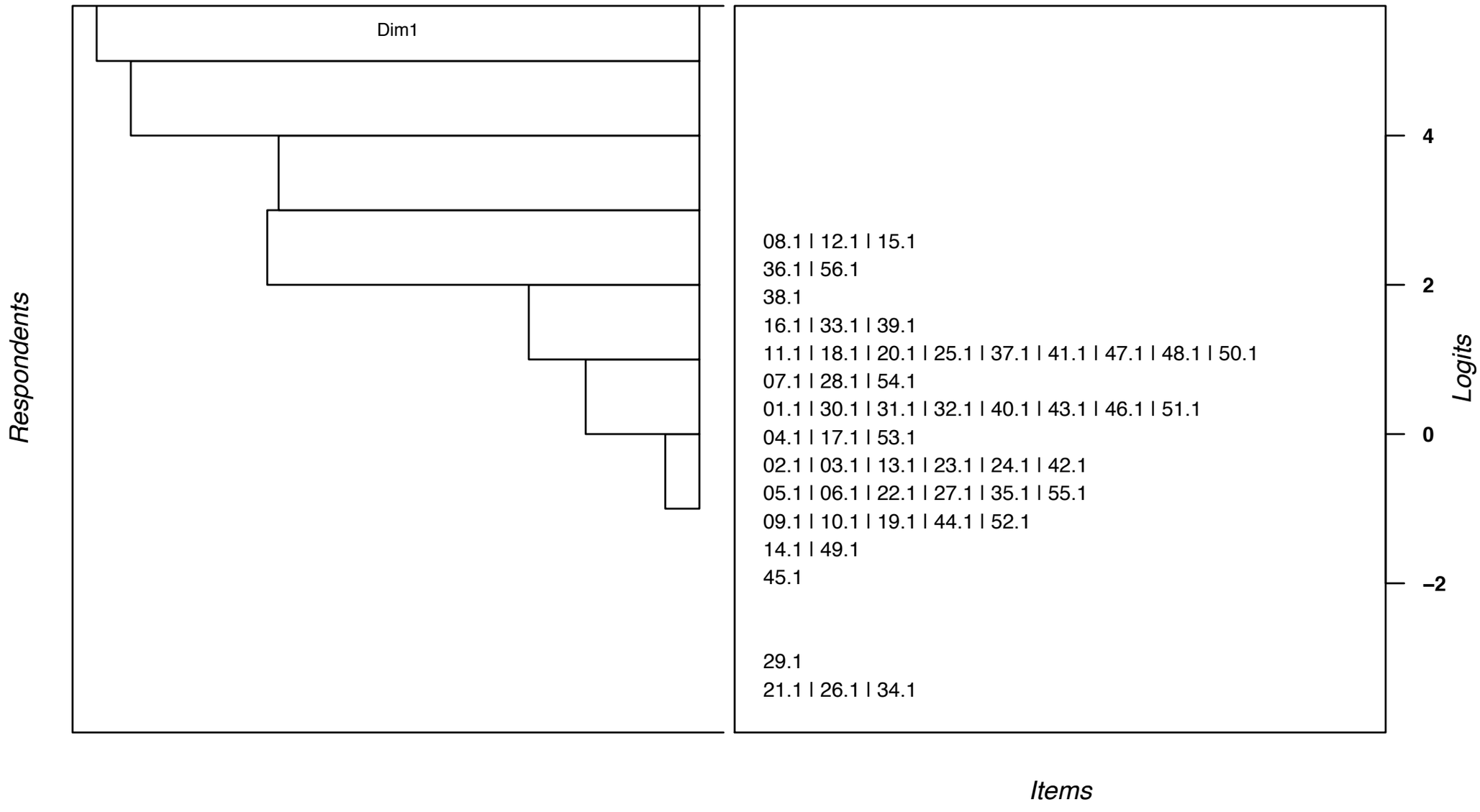
Install Wrightmap

Item-person plot:

```
wrightMap(personfit$EAP,itemfit$xsi,item.side =
itemClassic, item.prop = .5)
```

Plot

Wright Map



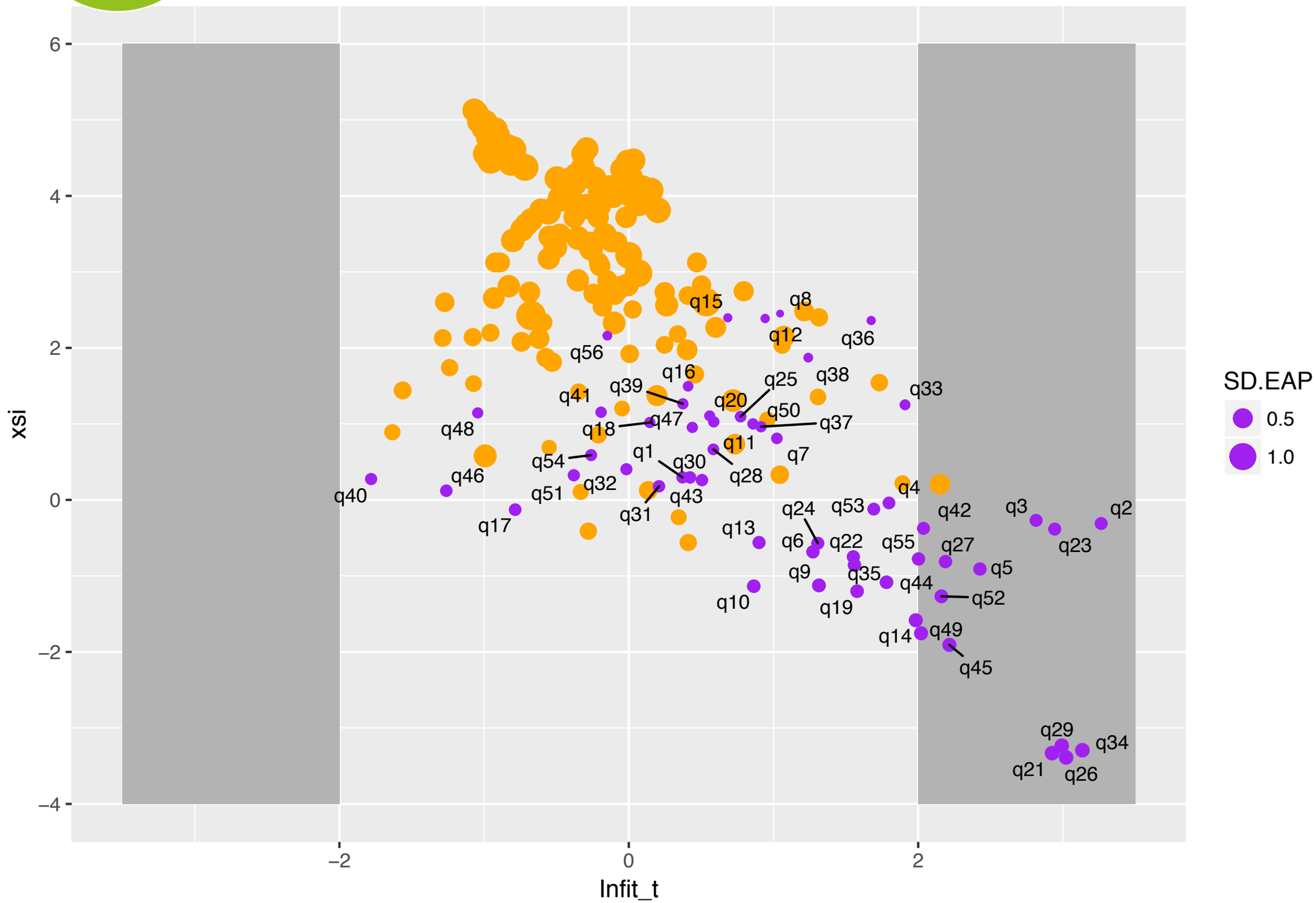
Pathway

Item-person pathway:

Plot, x-limits, rectangles indicating misfit, person-bubbles, item-bubbles, item-labels

```
ggplot(itemfit,aes(Infit_t,xsi))+ xlim(-3.5,3.5)+
geom_rect(aes(xmin=-3.5,xmax=-2,ymin=-4,ymax=6),fill="grey70")+
geom_rect(aes(xmin=2,xmax=3.5,ymin=-4,ymax=6),fill="grey70")+
geom_point(data=personfit,aes(x=infit.t,y=EAP,size=SD.EAP),color=
"orange")+geom_point(aes(size=se.xsi),color="purple")+
geom_text_repel(aes(label=label),size=3)
```

Plot


6
4
2
0
−2
−4
xsi
−2
0
2
lnfit_t
SD.EAP
0.5
1.0
q15
q8
q12
q36
q56
q16
q25
q38
q33
q41
q39
q20
q50
q37
q48
q18
q47
q11
q7
q1
q30
q54
q28
q46
q32
q51
q43
q40
q31
q17
q4
q24
q53
q42
q3
q2
q13
q6
q22
q55
q27
q23
q9
q35
q5
q44
q10
q19
q52
q14
q49
q45
q29
q34
q21
q26

Kidmap

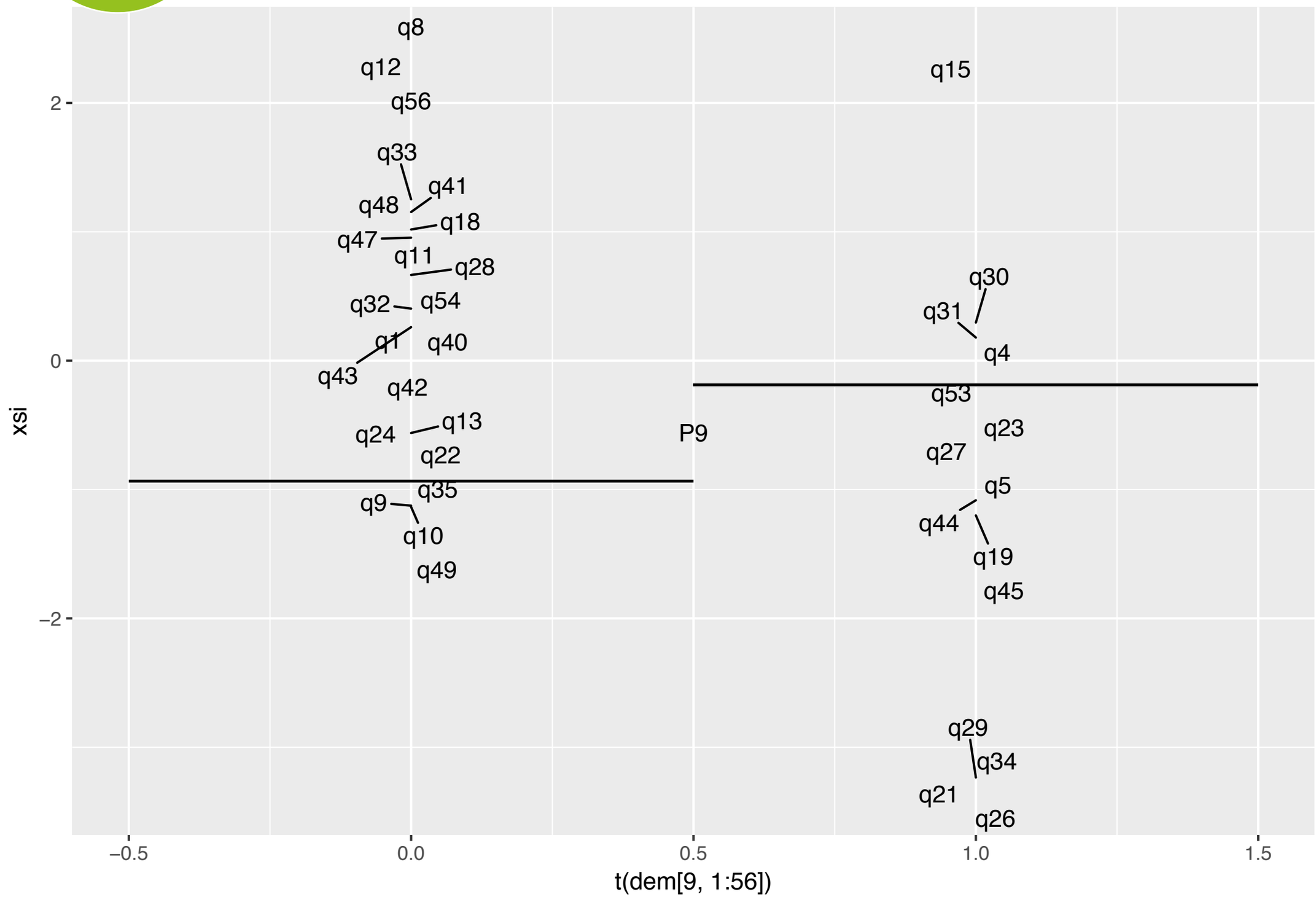
Kidmap for person 9 (low ability, slightly high outfit):

kid <- personfit[9,]

Item difficulties on left and right (depending on answer), person ability in the middle, two horizontal lines at +/- 1 SD

```
ggplot(itemfit,aes(y=xsi))+
geom_text_repel(aes(x=t(dem[9,1:56]),label=label))+
geom_text(data=kid,aes(y=EAP),label="P9",x=0.5)+
geom_segment(aes(y=kid$EAP+kid$SD.EAP,yend=kid$EAP+kid$SD.EAP,
x=0.5,xend=1.5))+ geom_segment(aes(y=kid$EAP-kid$SD.EAP,
yend=kid$EAP-kid$SD.EAP,x=-0.5,xend=.5))
```

Plot


q8
q12
q15
2
q56
q33
q41
q48
q18
q47
q11
q28
q30
q32
q54
q31
q1
q40
q4
0
q43
q42
q53
xsi
q24
q13
P9
q23
q22
q27
q35
q5
q9
q44
q10
q19
q49
q45
−2
q29
q34
q21
q26
−0.5
0.0
0.5
1.0
1.5
t(dem[9, 1:56])

Kidmap

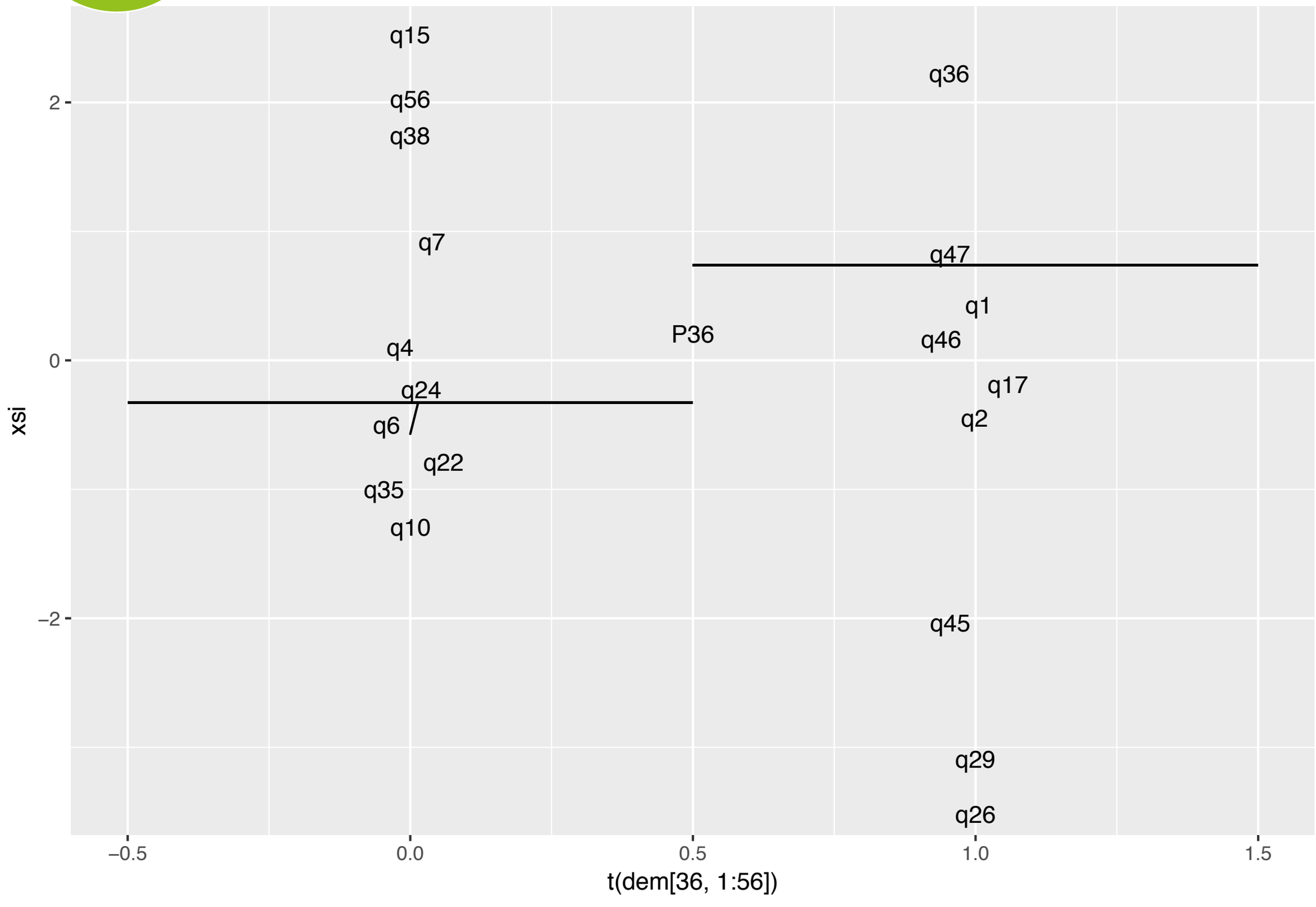
Kidmap for person 36 (average ability, high infit):

kid <- personfit[36,]

Item difficulties on left and right (depending on answer), person ability in the middle, two horizontal lines at +/- 1 SD

```
ggplot(itemfit,aes(y=xsi))+
geom_text_repel(aes(x=t(dem[36,1:56]),label=label))+
geom_text(data=kid,aes(y=EAP),label="P36",x=0.5)+
geom_segment(aes(y=kid$EAP+kid$SD.EAP,yend=kid$EAP+kid$SD.EAP,
x=0.5,xend=1.5))+ geom_segment(aes(y=kid$EAP-kid$SD.EAP,
yend=kid$EAP-kid$SD.EAP,x=-0.5,xend=.5))
```

Plot


q15
q36
q56
q38
q7
q47
q1
P36
q46
q4
q17
q24
q2
q6
q22
q35
q10
q45
q29
q26
2
0
−2
xsi
−0.5
0.0
0.5
1.0
1.5
t(dem[36, 1:56])

Kidmap

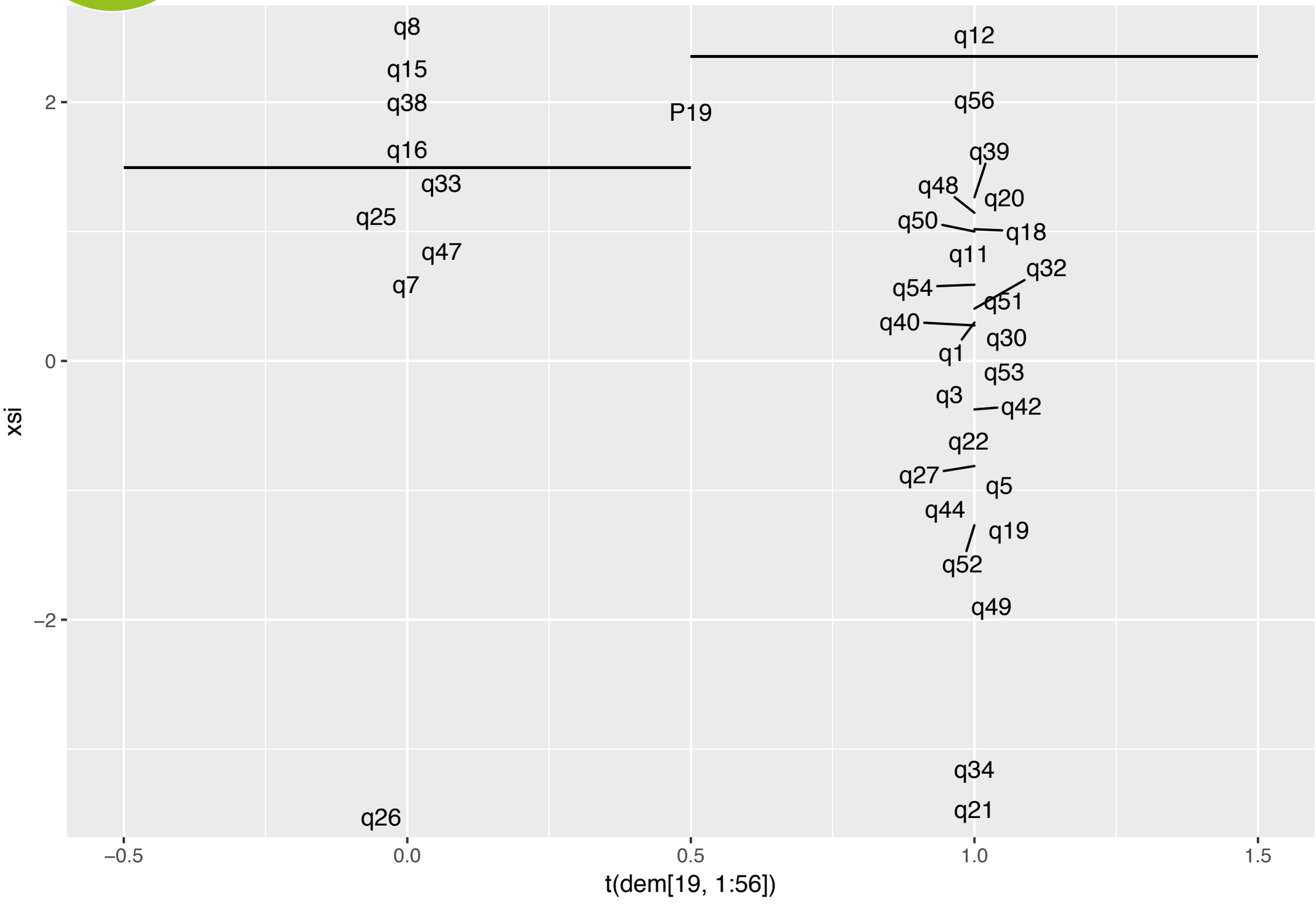
Kidmap for person 19 (high ability, high outfit):

kid <- personfit[19,]

Item difficulties on left and right (depending on answer), person ability in the middle, two horizontal lines at +/- 1 SD

```
ggplot(itemfit,aes(y=xsi))+
geom_text_repel(aes(x=t(dem[19,1:56]),label=label))+
geom_text(data=kid,aes(y=EAP),label="P19",x=0.5)+
geom_segment(aes(y=kid$EAP+kid$SD.EAP,yend=kid$EAP+kid$SD.EAP,
x=0.5,xend=1.5))+ geom_segment(aes(y=kid$EAP-kid$SD.EAP,
yend=kid$EAP-kid$SD.EAP,x=-0.5,xend=.5))
```

Plot


q8
q15
q38
q16
q33
q25
q47
q7
q12
P19
q56
q39
q48
q20
q50
q18
q11
q32
q54
q51
q40
q30
q1
q53
q3
q42
q22
q27
q5
q44
q19
q52
q49
q34
q21
q26
2
0
−2
xsi
−0.5
0.0
0.5
1.0
1.5
t(dem[19, 1:56])

“It is the mark of a truly intelligent person
to be moved by statistics.”

T H A N K S !

George Bernard Shaw