An application of the new `irt` command in Stata

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What we would like to do:

Be able to measure the health status of a person 60 years old or older.

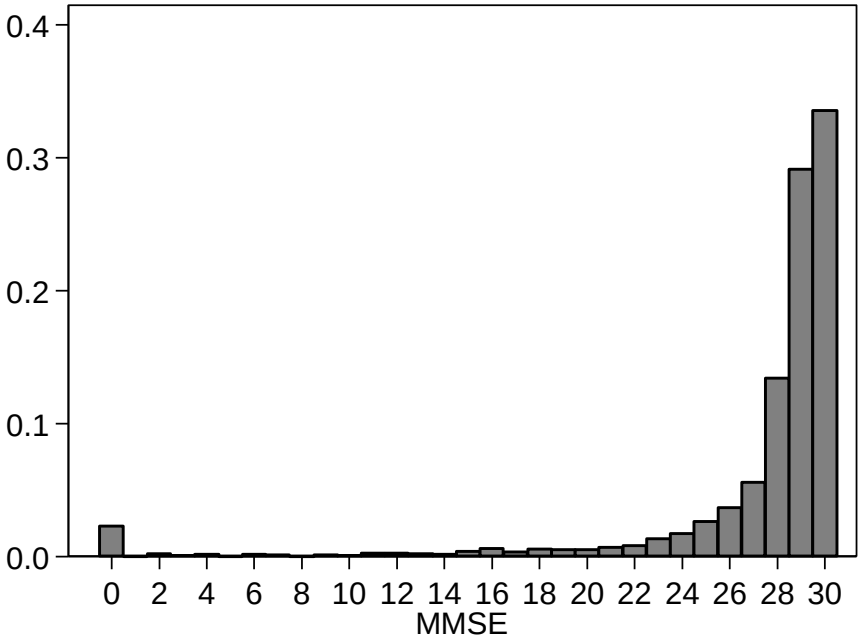
What we can do:

measure several indicators of health

What we can do: measure...

Cognitive functioning: MMSE test

- bounded variable
- integer values
- skewed to the left



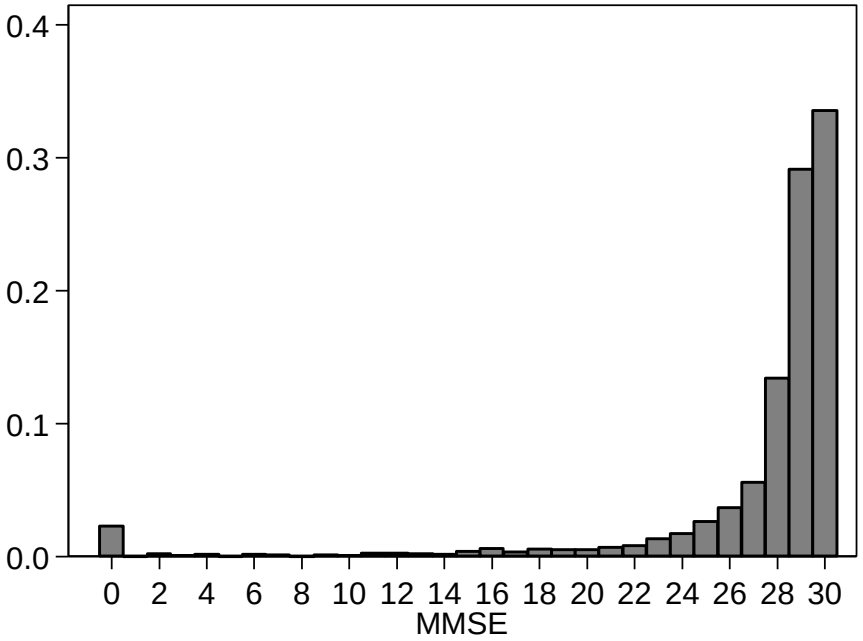
What we can do: measure...

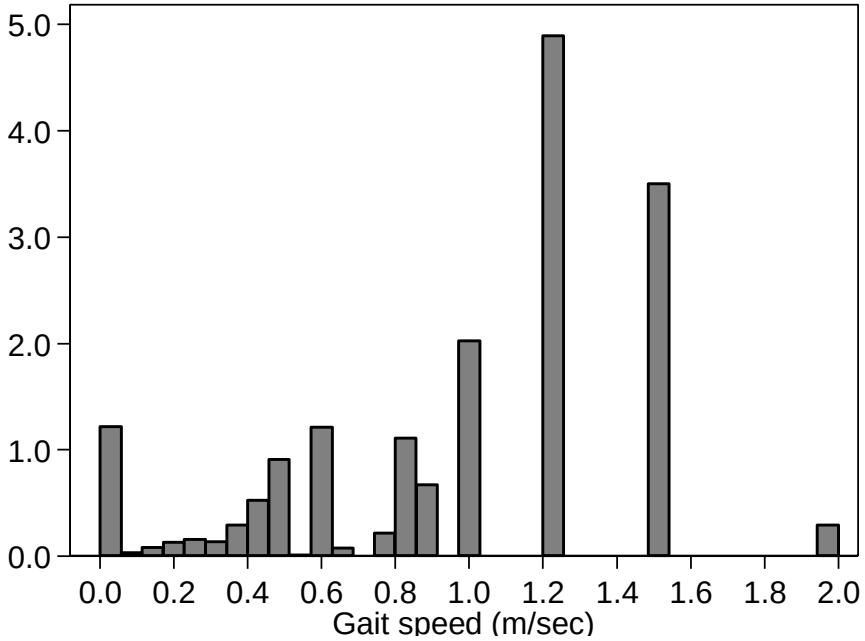
Cognitive functioning: MMSE test

- bounded variable
- integer values
- skewed to the left

Physical functioning: gait speed

- only positive values
- not really continuos

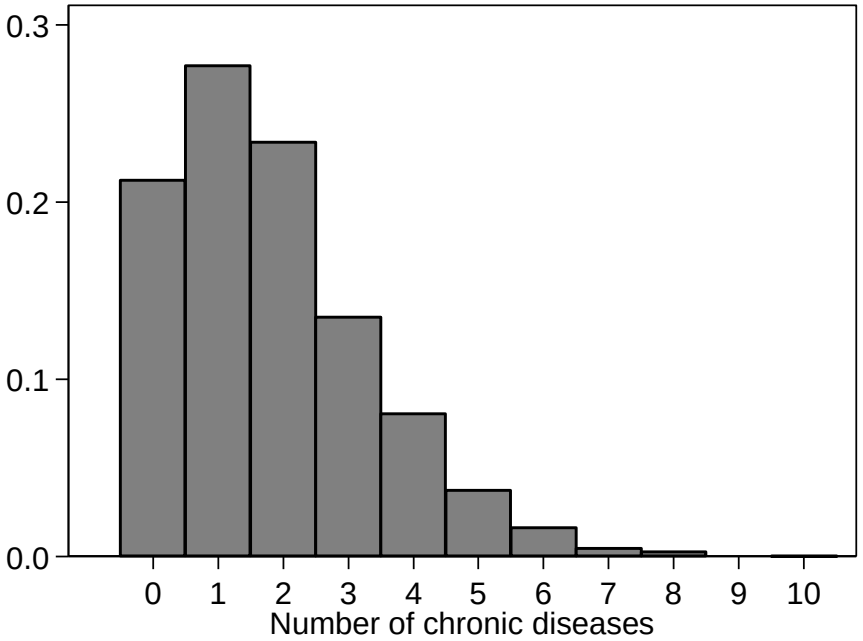




What we can do: measure...

Morbidities: # of chronic diseases

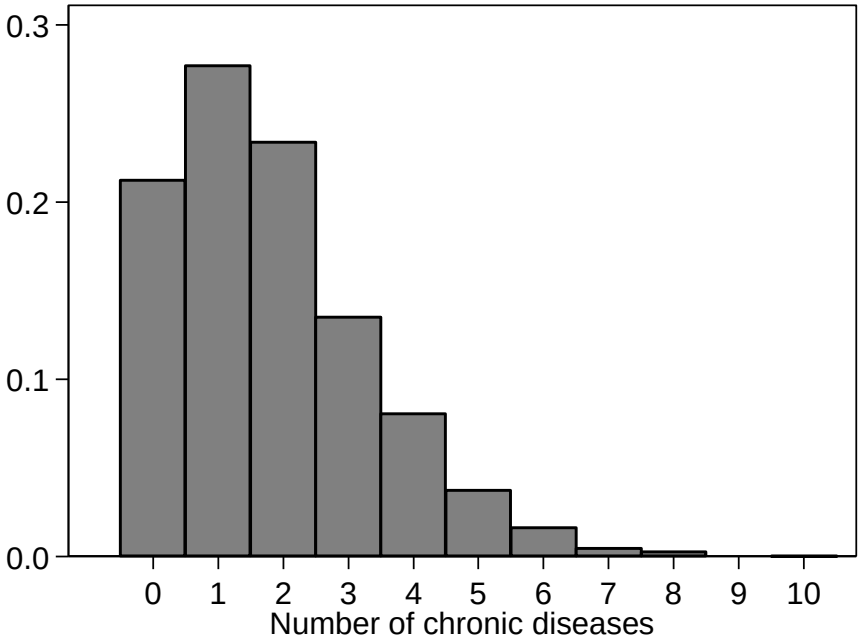
- bounded variable
- integer values
- skewed to the right

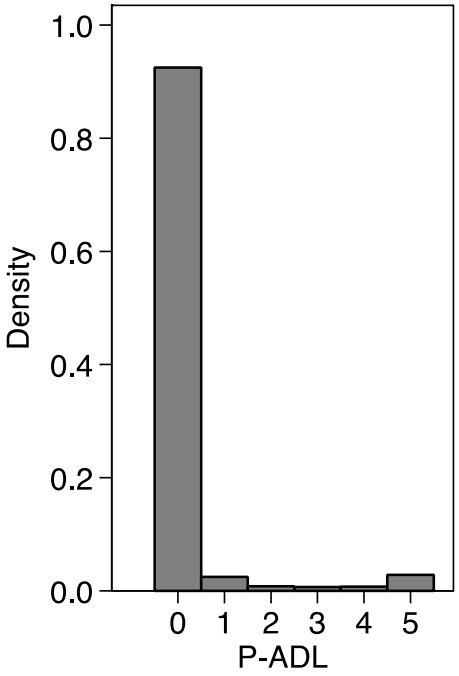


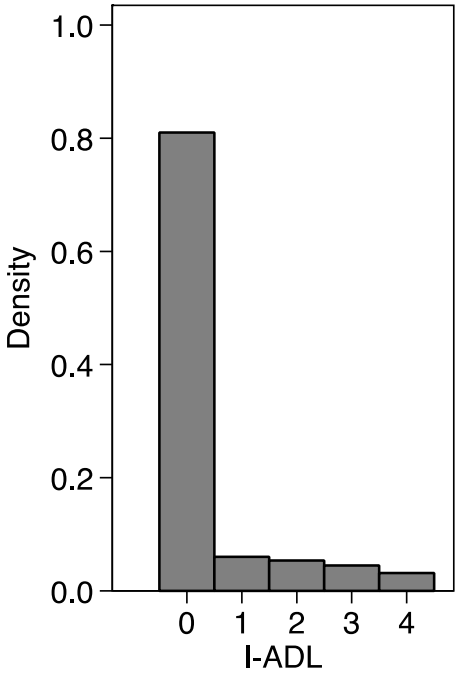
What we can do: measure...

Morbidities: # of chronic diseases
- bounded variable
- integer values
- skewed to the right

Disability: personal- instrumental- activities of daily living (PADL IADL)
- bounded
- zero inflated







Aim: Create an health index

Problem: How to treat the available variables?
Which cut-offs to use?

Solution: Use nominal response model

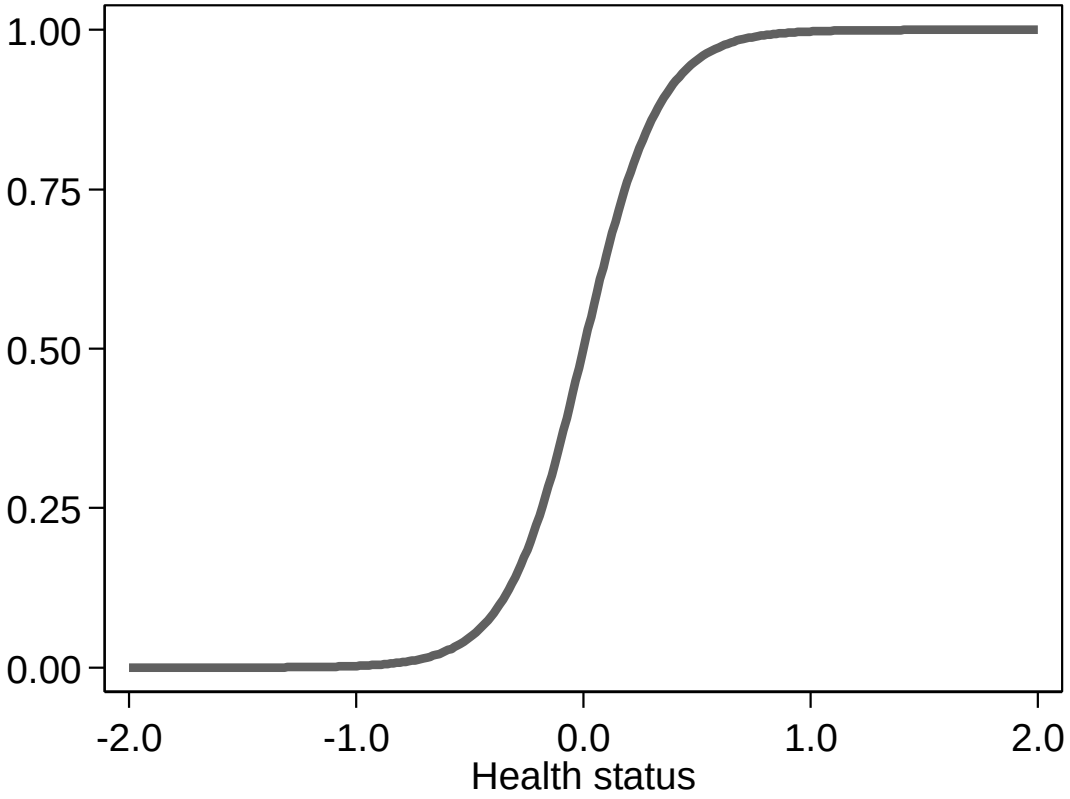
1) items can have different number of categories
2) no order is given to the categories
3) it allows us to find the cut-off points for each item that results in the best test

Item Information Curve

Question:

Is the patient's gait speed fast?

Given the patient's health status, what is the patient's probability of answering yes?



Item Characteristic Curve

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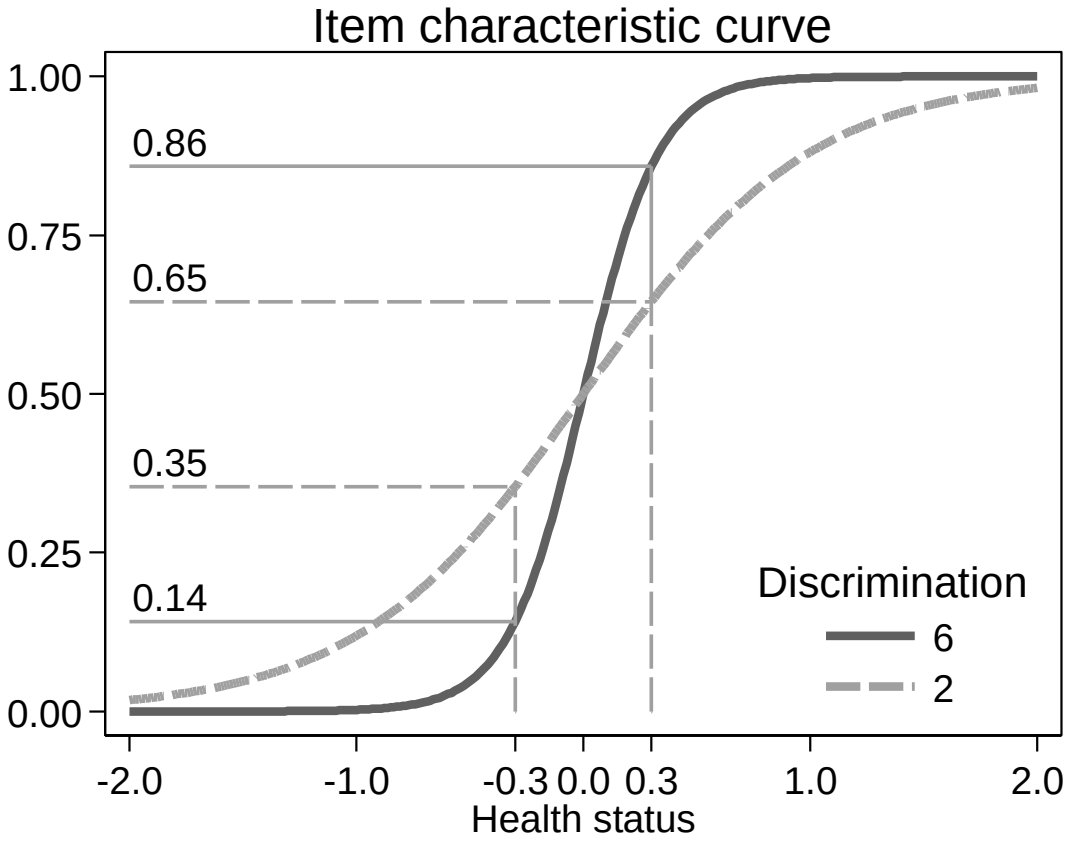

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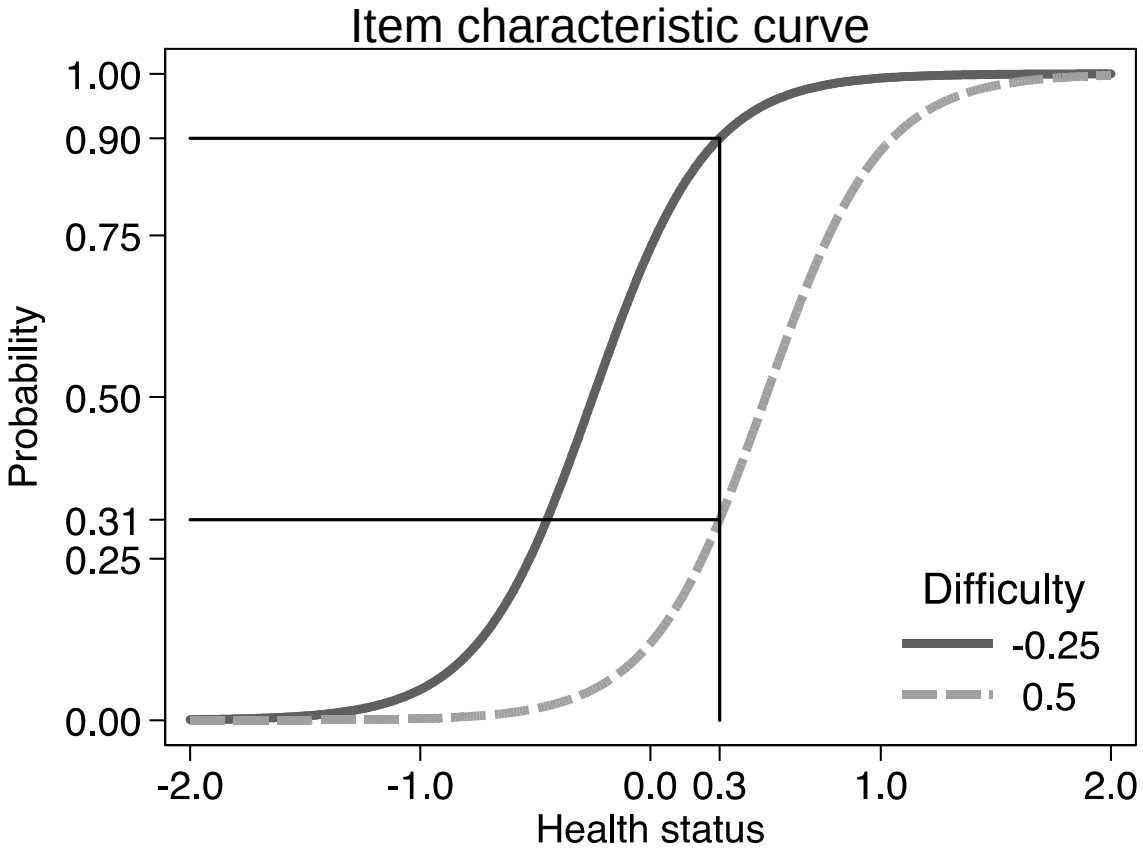
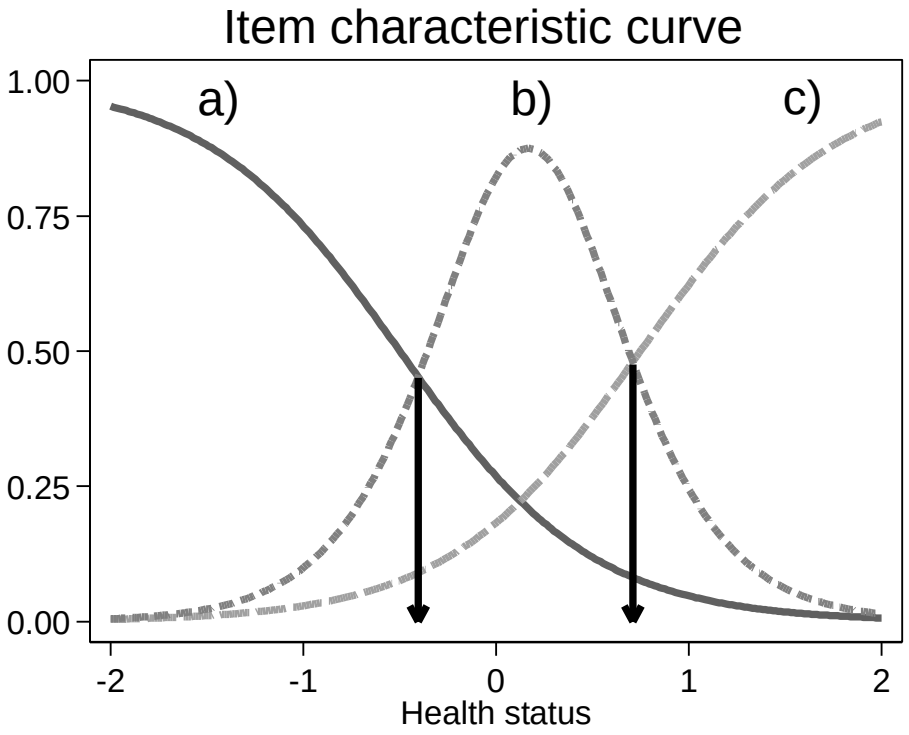


Item Characteristic Curve

Question:

Is the patient's gait speed a) slow, b) medium, or c) fast?

Given the patient's health status, what is the patient's probability of answering a), b), or c)?



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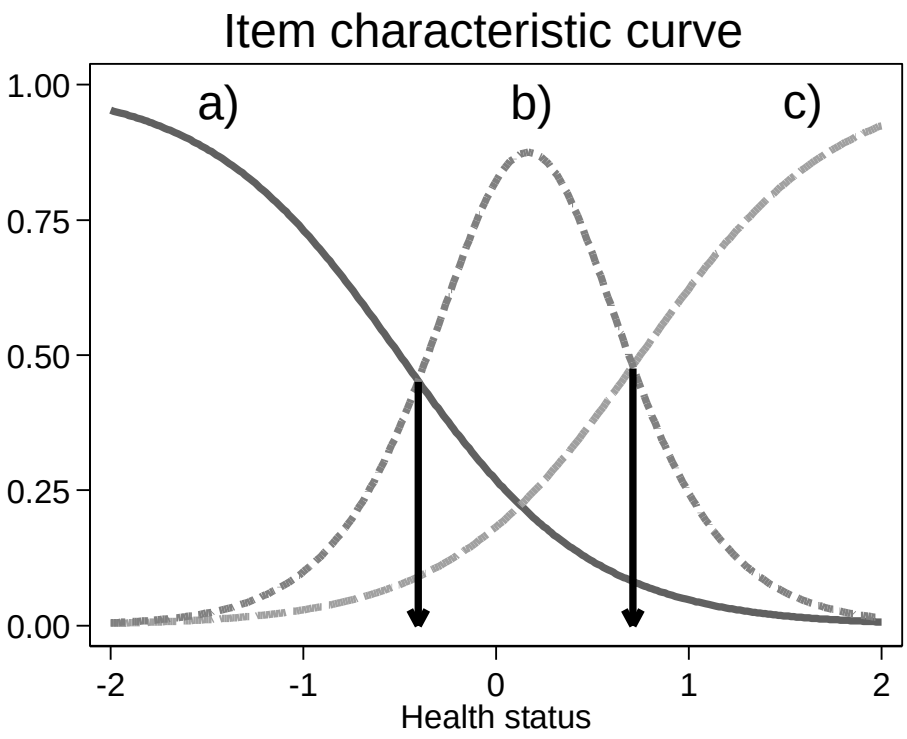
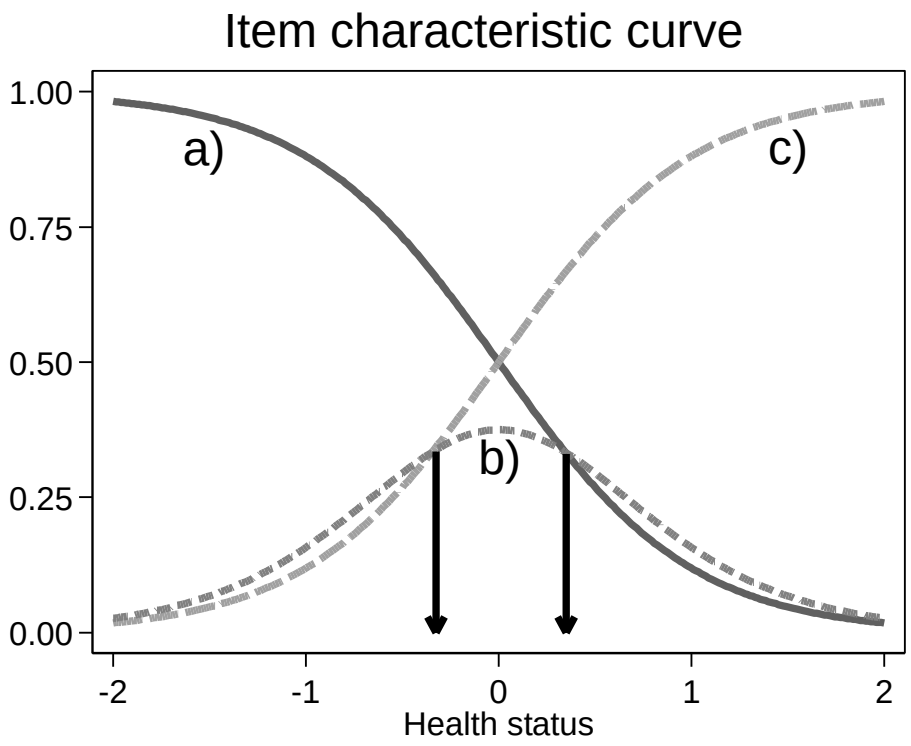
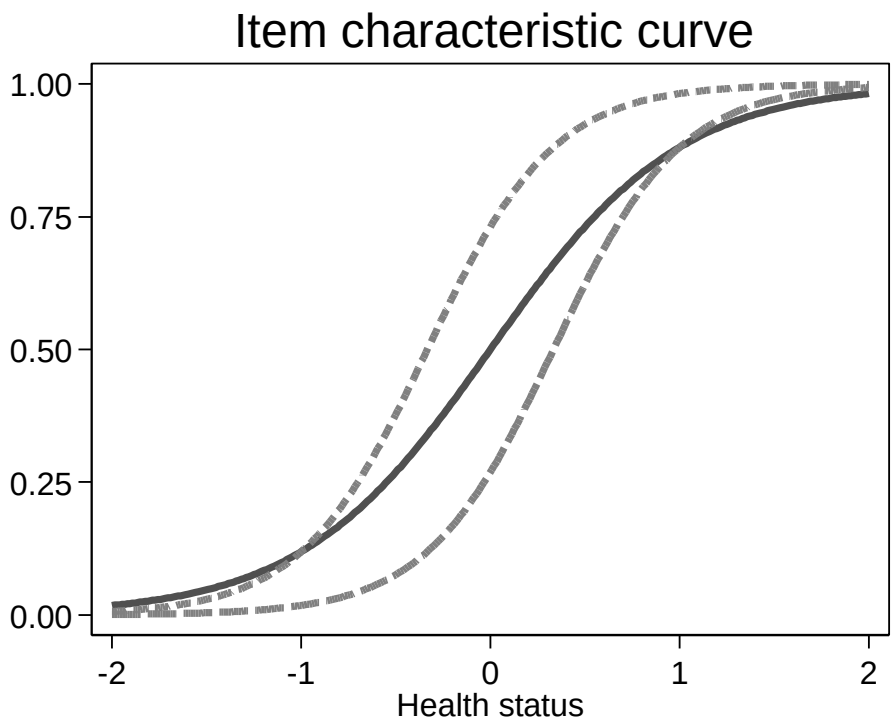
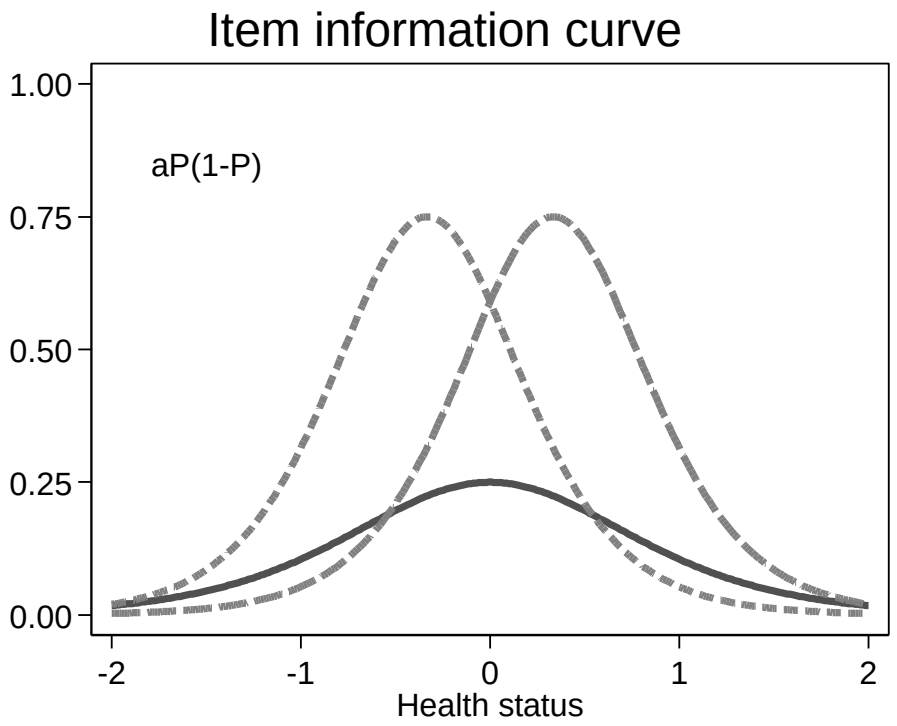




Item Information Curve

The item information curve is a function of the descriminant and the probability of the answer.





Health Index

Requirements for the health index:

1) differentiate people across the different levels of health.
   a. Difficulty values for questions with three or more categories in order.
   b. Difficulty values evenly distributed across the latent trait.

2) discriminate people of similar level of health and be precise over a large range of the latent trait.
   a) High discriminant values.
   b) Large information function.

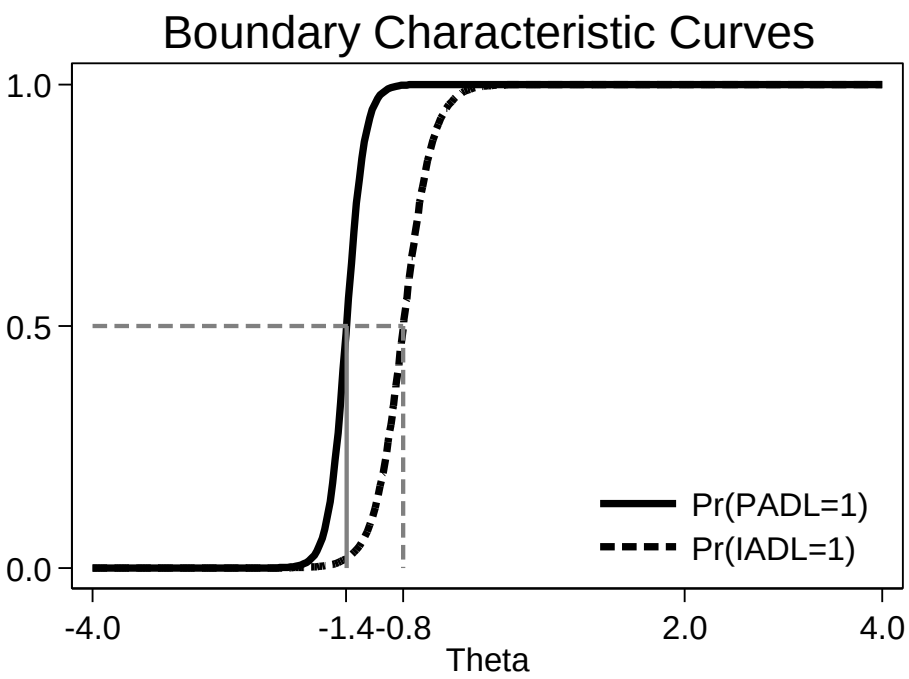
```
irt nrm PADL IADL Gait MMSE Morb, intpoints(50)
```

Nominal response model — Number of obs = 3,363
Log likelihood = -10848.84

		Coef.	Std.Err.	z	P>z	[95% Conf.	Interval]
PADL	Discrim 1 vs 0	11.07	2.82	3.93	0.000	5.55	16.60
	Diff 1 vs 0	-1.43	0.03	-42.09	0.000	-1.49	-1.36
IADL	Discrim 1 vs 0	6.80	0.87	7.82	0.000	5.09	8.50
	Diff 1 vs 0	-0.85	0.03	-31.79	0.000	-0.90	-0.80
Gait	Discrim 1 vs 0	4.58	0.41	11.16	0.000	3.78	5.38
	2 vs 0	8.53	0.67	12.81	0.000	7.23	9.84
	3 vs 0	9.77	0.73	13.45	0.000	8.34	11.19
	Diff 1 vs 0	-1.19	0.03	-35.57	0.000	-1.26	-1.13
	2 vs 0	-0.75	0.04	-20.55	0.000	-0.82	-0.68
	3 vs 0	-0.51	0.04	-12.26	0.000	-0.59	-0.43
MMSE1	Discrim 1 vs 0	3.90	0.36	10.93	0.000	3.20	4.60
	2 vs 0	5.26	0.37	14.22	0.000	4.54	5.99
	Diff 1 vs 0	-1.54	0.04	-36.11	0.000	-1.63	-1.46
	2 vs 0	-1.29	0.03	-37.05	0.000	-1.36	-1.22
Morb	Discrim 1 vs 0	0.60	0.05	10.94	0.000	0.49	0.70
	2 vs 0	1.35	0.08	16.60	0.000	1.19	1.51
	Diff 1 vs 0	-1.27	0.11	-11.12	0.000	-1.50	-1.05
	2 vs 0	0.27	0.05	5.50	0.000	0.17	0.36

Health Index

```
irtgraph icc PADL IADL, ///
    blocation plocation
```



PADL Discrim 1 vs 0	11.07	2.82
Diff 1 vs 0	-1.43	0.03
IADL Discrim 1 vs 0	6.80	0.87
Diff 1 vs 0	-0.85	0.03

```
irtgraph icc Gait, ///
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```
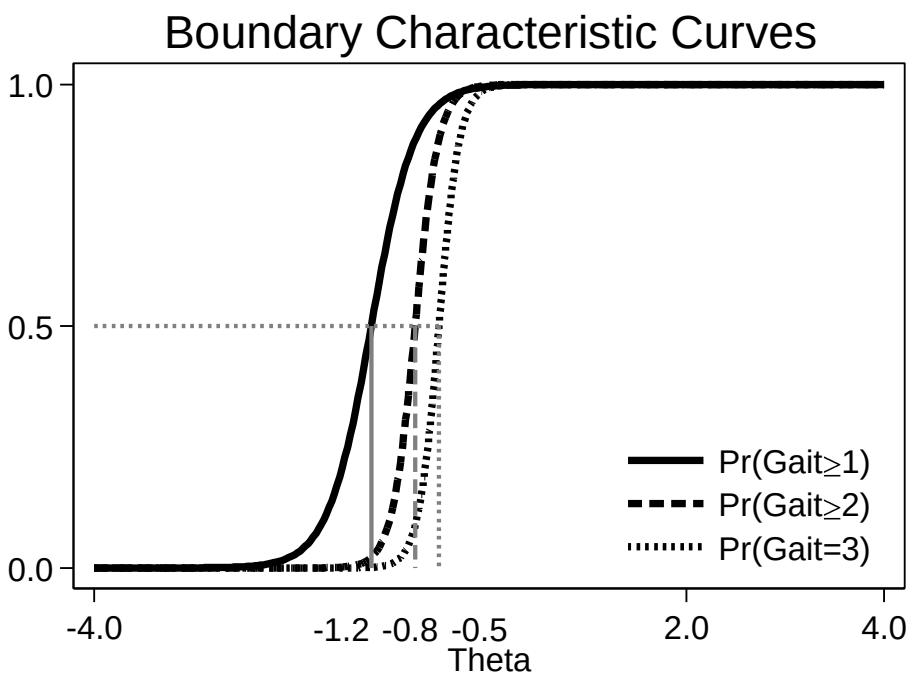
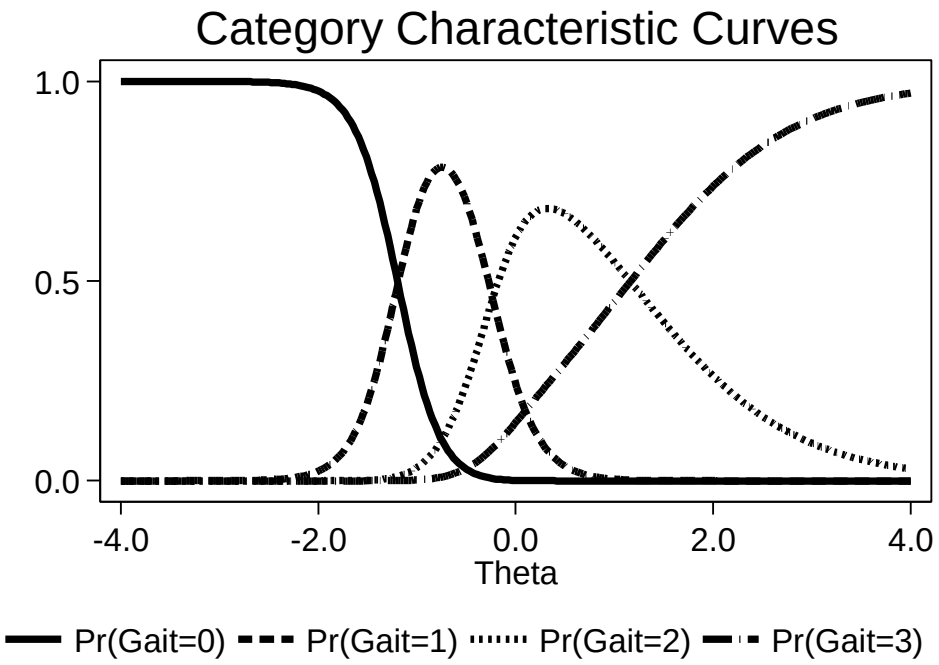



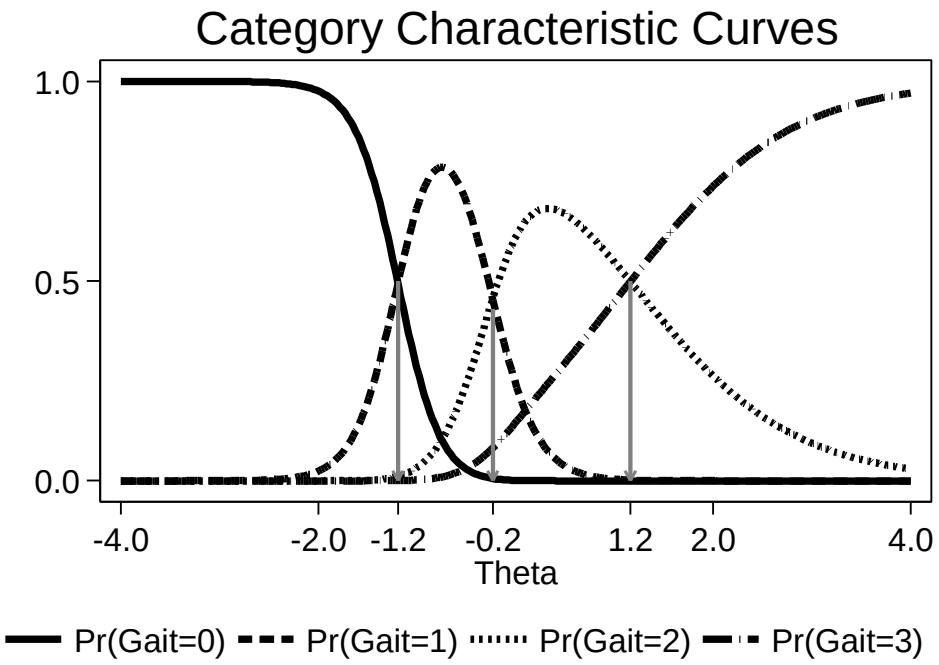
Gait Discrim 1 vs 0	4.58	0.41
2 vs 0	8.53	0.67
3 vs 0	9.77	0.73
Diff 1 vs 0	-1.19	0.03
2 vs 0	-0.75	0.04
3 vs 0	-0.51	0.04

Health Index




```
irtgraph icc Gait, ccc
```

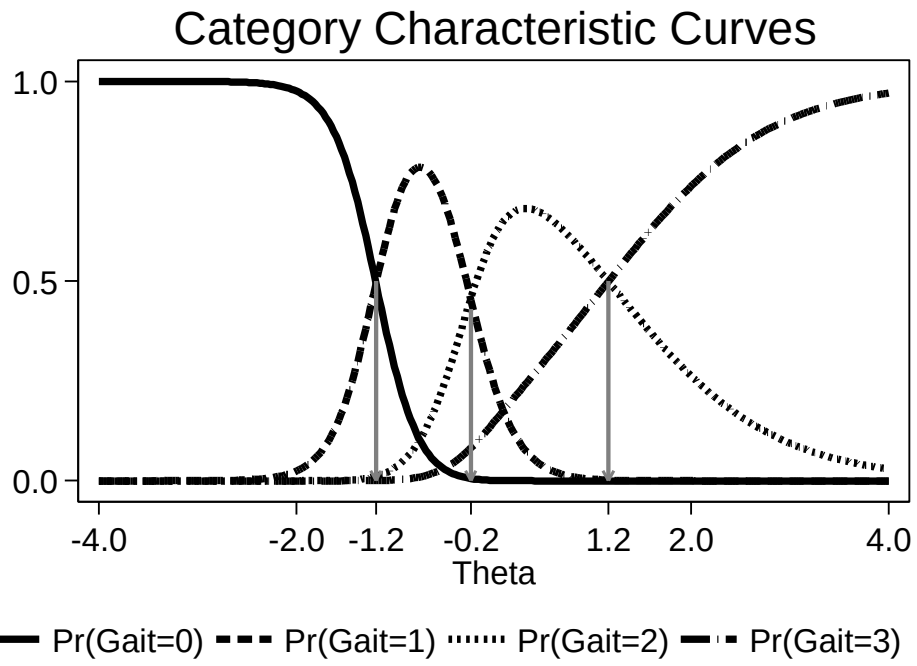
Health Index

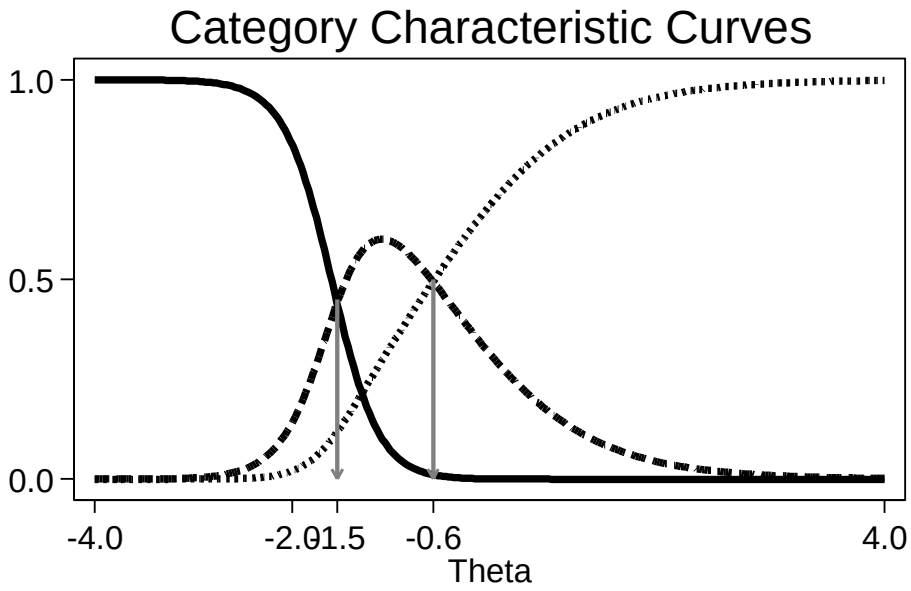


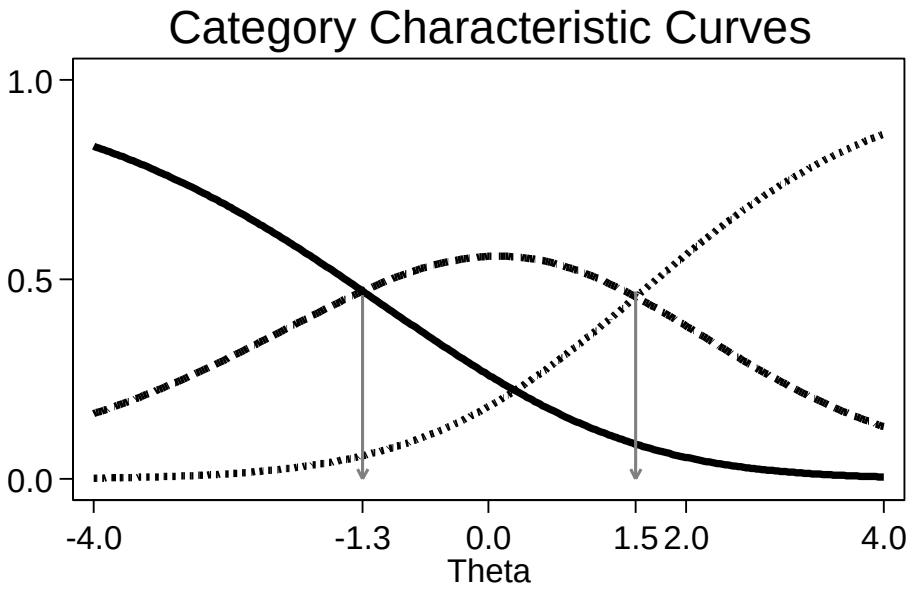
$$Diff = (Diff_i - Diff_{i-1})/(Discrim_i - Discrim_{i-1})$$

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
A	-1.19	0.03	-35.57	0.000	-1.26	-1.13
B	-0.23	0.03	-9.02	0.000	-0.28	-0.18
C	1.16	0.09	13.02	0.000	0.99	1.34

Health Index

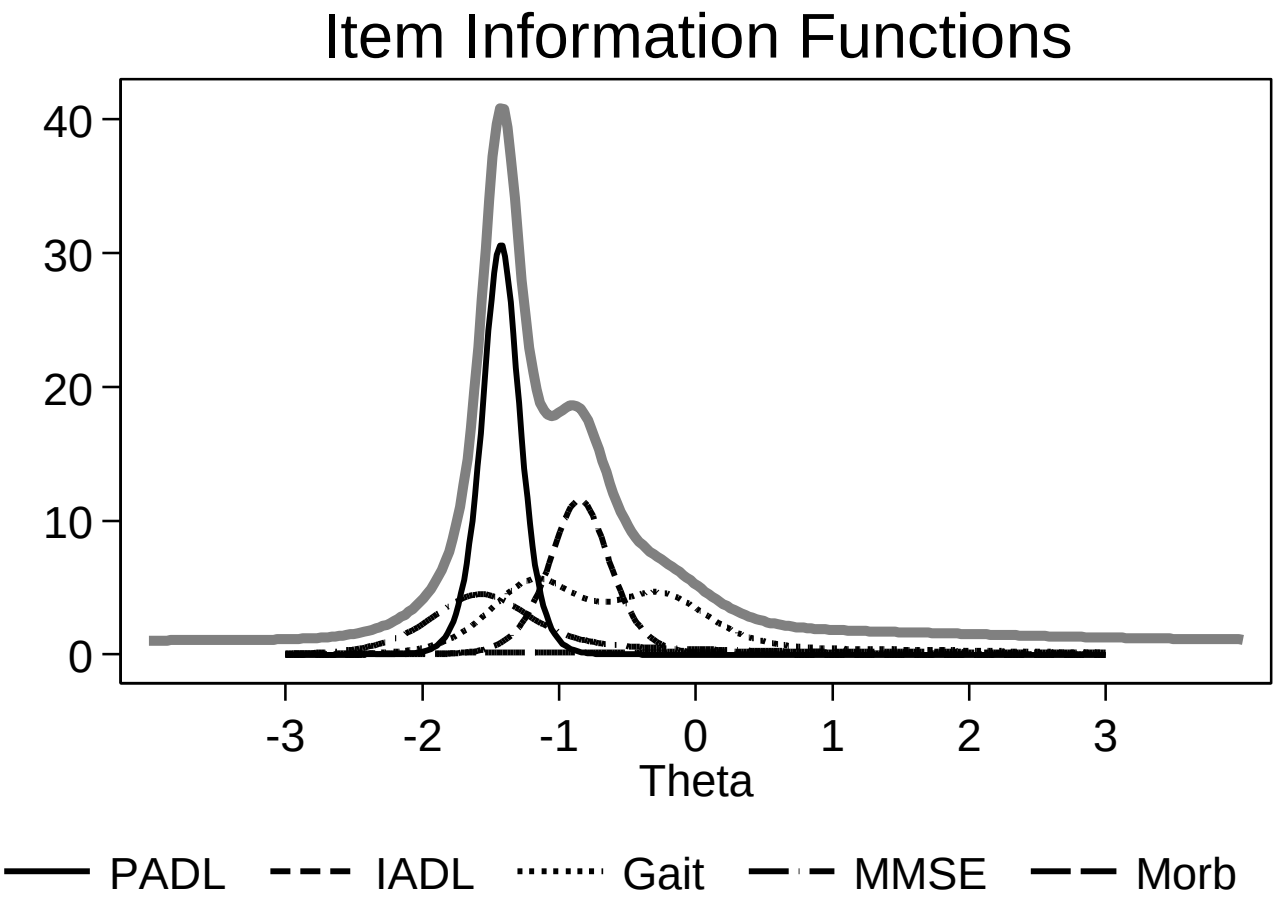






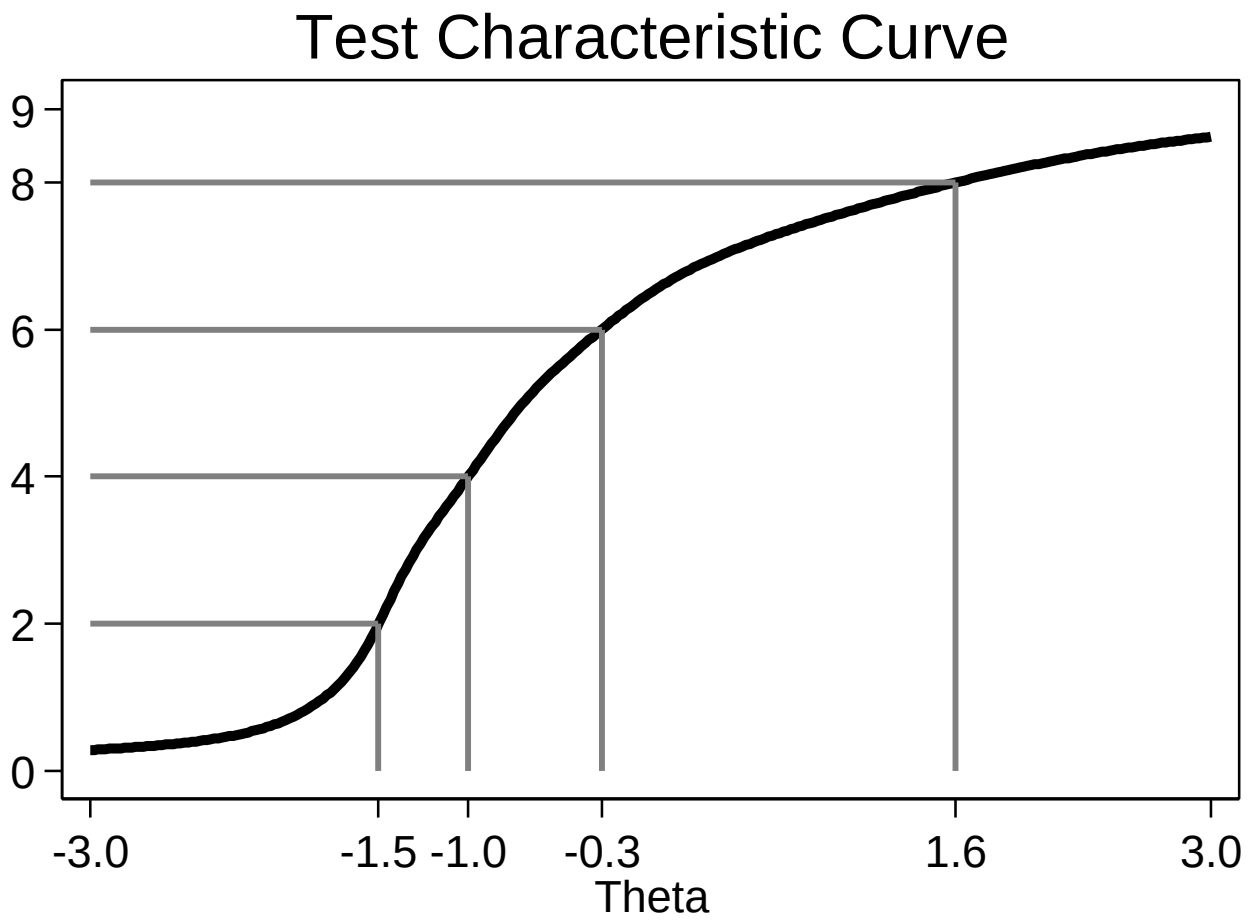
Health Index

```
irtgraph tif, data(A,replace)
merge using A
irtgraph iif PADL IADL Gait MMSE Morb, range(-3 3)
    addplot(line tif theta)
```



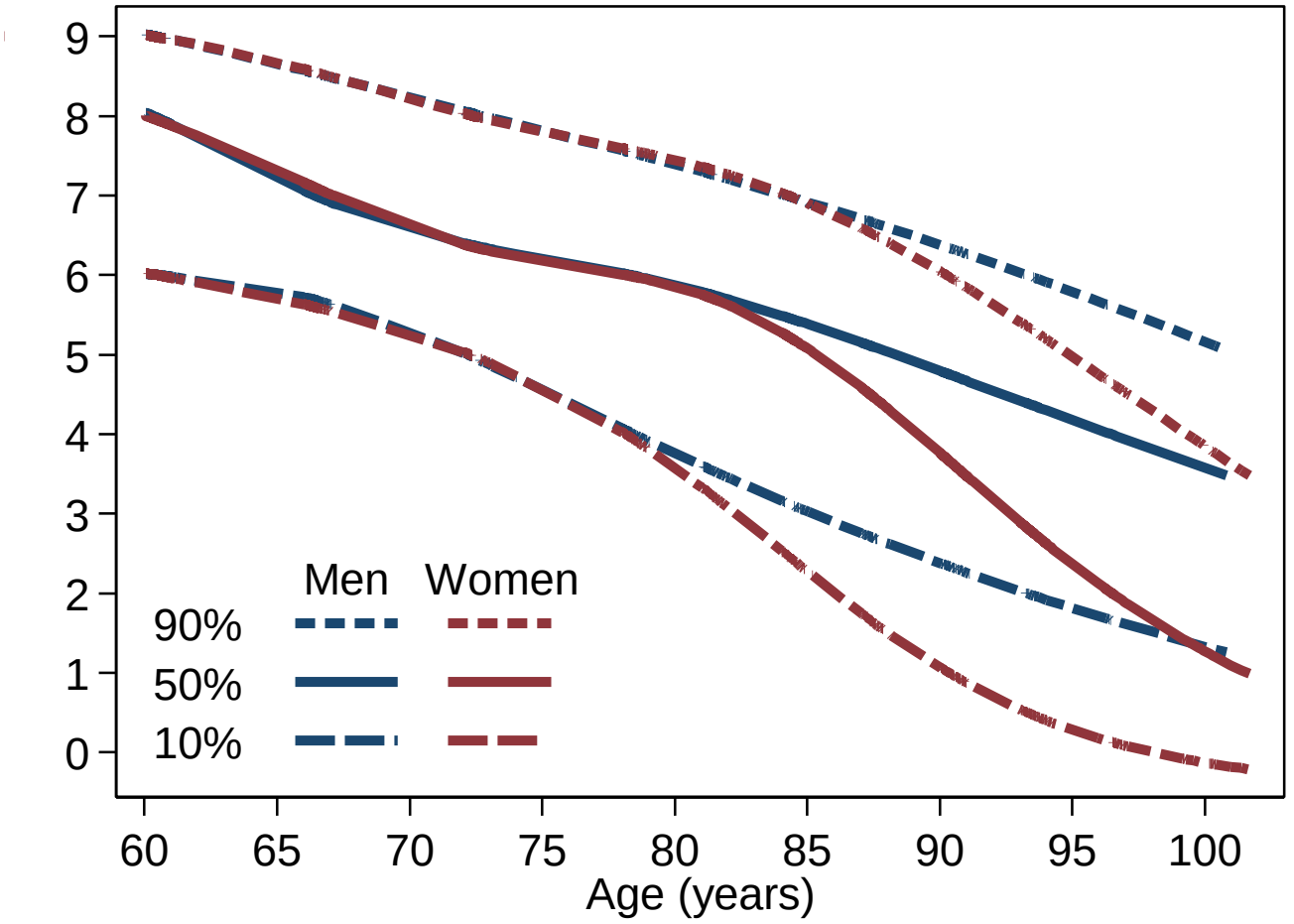
Health Index

```
irtgraph tcc, range(-3 3) scorelines(2 4 6 8,
lwidth(medthick) lcolor(gs8))
```



Health Index

Health index by sex and age



Health Index

Area under the receiver operating characteristic (ROC) curve in predicting time to death within 5 years

	Health index		Multi Prognostic Index		
	ROC Area	**95%CI**	**ROC Area**	**95%CI**	**p-value**
All	0.82	(0.79, 0.84)	0.77	(0.75, 0.80)	**<0.001**
60-79	0.73	(0.69, 0.77)	0.69	(0.65, 0.73)	**0.050**
80+	0.74	(0.71, 0.78)	0.71	(0.67, 0.75)	0.028