

# Interactive ENEM: exams with statistics and free access

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# Motivation

- How to help ENEM candidates?
  - Provision of old exams
  - Provision of templates
  - Provides statistics including Item Response Theory (IRT) - adopted in ENEM
  - Providing an interactive system to assist candidates

# Theoretical Fundamentals of IRT

- We adopt the 3PLM (three-parameter a, b and c logistic model - adopted in ENEM) that computes the probability of the  $j$ th candidate's answer to be correct for a given dichotomous item  $i$ .

$$P(X_{ij} = 1|\theta_j) = c_i + \frac{1 - c_i}{1 + e^{-Da_j(\theta_j - b_i)}}$$

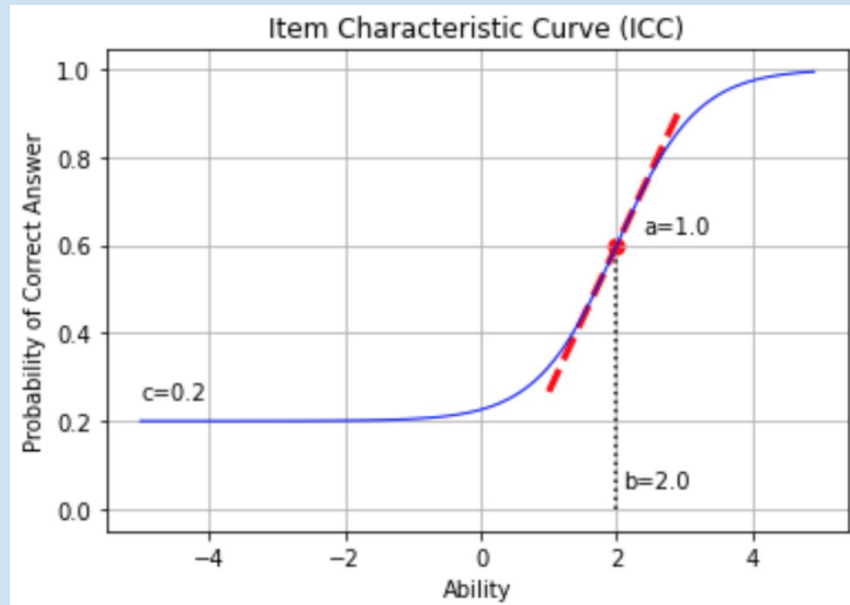
a - discrimination

b - ability

c - causality

# Theoretical Fundamentals of IRT

$$P(X_{ij} = 1|\theta_j) = c_i + \frac{1 - c_i}{1 + e^{-Da_j(\theta_j - b_i)}}$$



a=1 - discrimination

b=2 - ability

c=0.2 - causality

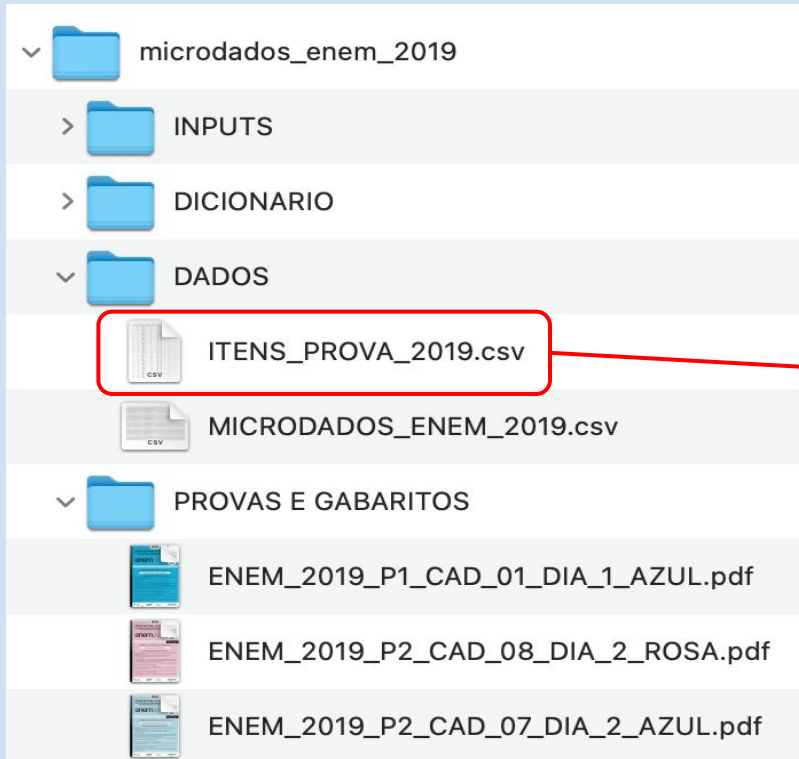
$X_{ij}$  = matrix of responses from all candidates  $j$

Try other values: [Colab](#)

# Method

- This work was developed from ENEM microdata, made available by INEP (case study for 2019):  
[\[https://www.gov.br/inep/pt-br/aceso-a-informacao/dados-abertos/microdados/enem\]](https://www.gov.br/inep/pt-br/aceso-a-informacao/dados-abertos/microdados/enem)
- Three steps:
  - A. Converting templates from CSV format to JSON
  - B. Statistics: for each ENEM item, calculate the mean, standard deviation and IRT parameters
  - C. Convert exams from PDF to HTML format
- ***ENEM Interativo*** portal:

# Method: A. Converting templates from CSV format to JSON



```
▼ 503:  
  COR:           "AZUL"  
  AREA:          "CN"  
  ▼ QUESTIONS:  
    ▼ 10:  
      answer:    "D"  
      ability:   29  
      id:        7529  
      percentage: 0  
      irt:       []  
      ▼ images:  
        0:       "503_010000_fig_tri_010.png"  
        1:       "503_010000_fig_box_010.png"  
      videos:   []  
      subareas: []
```

in order to facilitate the inclusion of more information

# Method: A. Converting templates from CSV format to JSON

fields were added:

- 1) **percentage**, with the percentage of success in a sample;
- 2) **irt**, with the IRT parameters;
- 3) **images**, with a list of images;
- 4) **videos**, with videos explaining each subject;
- 5) **subareas**, with information about each sub-area of the question.

```
▼ 503:
  COR:           "AZUL"
  AREA:          "CN"
  ▼ QUESTIONS:
    ▼ 10:
      answer:    "D"
      ability:   29
      id:        7529
      percentage: 0
      irt:       []
      ▼ images:
        0:       "503_010000_fig_tri_010.png"
        1:       "503_010000_fig_box_010.png"
      videos:    []
      subareas:  []
```

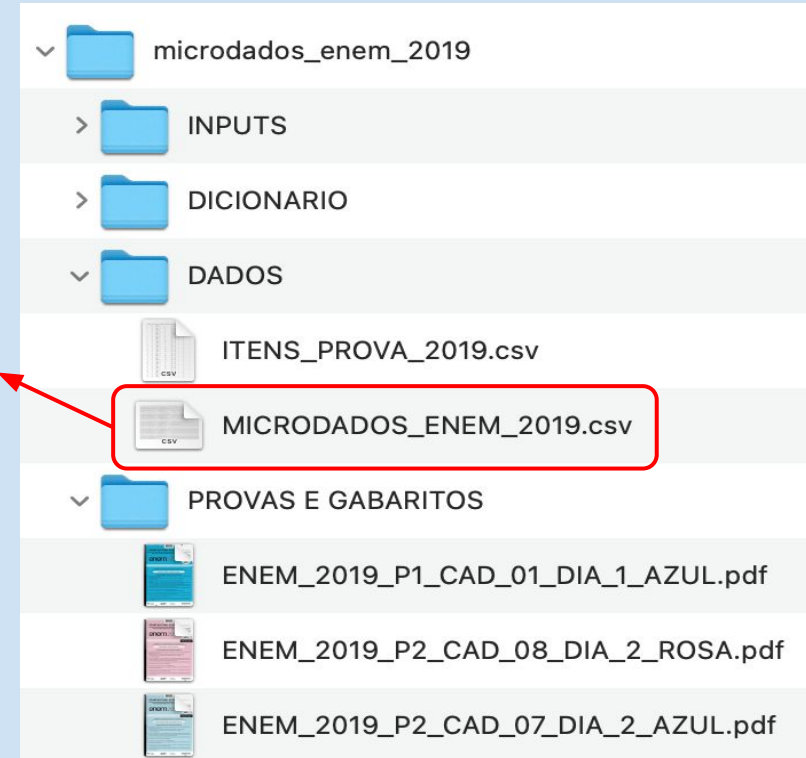


## Method: **B. Statistics - Processing the MICRODADOS\_ENEM\_2019.csv file**

The 3.2 GByte file contains all of the candidate's responses, plus various other information such as:

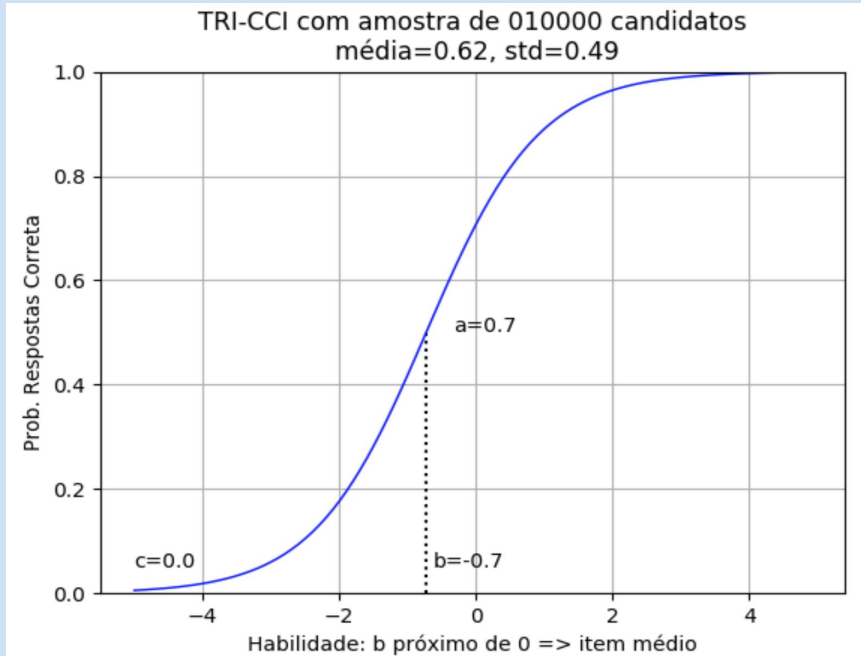
- the student's background (whether public choice or not),
- their socioeconomic data, and
- other information collected from the candidate's application.

It is noteworthy that these data do not identify the candidate.

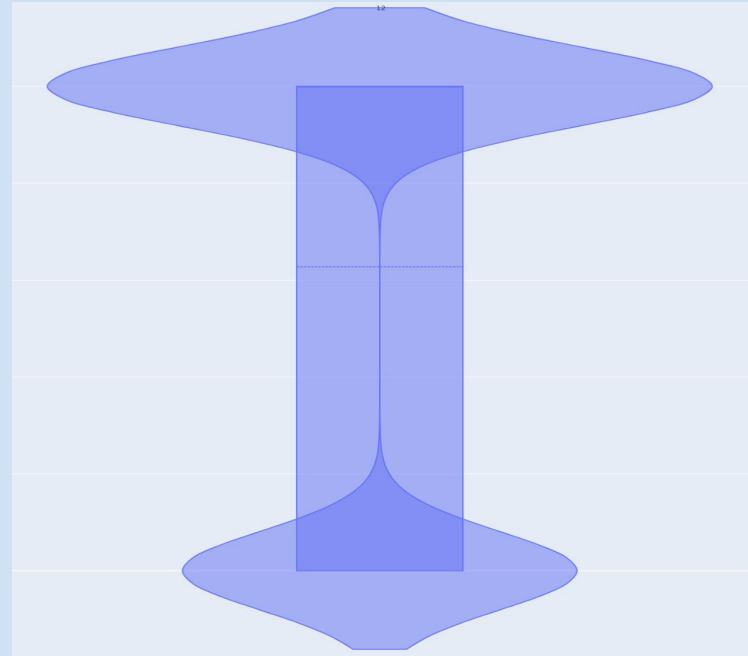


# Method: **B. Statistics - Processing the MICRODADOS\_ENEM\_2019.csv file**

The result of this processing was consolidated into two graphs per question



Item Characteristic Curve (CCI)



BoxPlot graph together with Violin Plot

## Method: C. Convert exams from PDF to HTML format

- We use the pdf2htmlEX library:
  - <https://github.com/pdf2htmlEX/pdf2htmlEX>
- After converting from PDF to HTML, several Python scripts were created to include the interactive part in the ENEM Interactive portal, available:
  - <https://github.com/fzampirolli/ENEM>

# Method: **ENEM Interativo** - <http://vision.ufabc.edu.br/MCTest/ENEM>

## ENEM Interativo

Interativo:

[2019](#)

### Microdados do ENEM

Este portal tem como objetivo deixar os exames do ENEM interativos.

O estudante pode ver as questões no formato do ENEM, seus acertos, [estatísticas](#), etc.

Errar as questões \*fáceis\* é muito pior do que as difíceis ([pela Teoria de Resposta ao Item utilizada pelo ENEM para atribuir as habilidades/pontuações de cada candidato](#))! [Veja um vídeo explicativo.](#)

Navegue pelo ano à esquerda e abra os arquivos com os exames interativos.

Bons Estudos!

Fonte: [INEP](#) e [pdf2htmlEX](#)

Ajude a melhorar esse serviço gratuito: [Formulário](#) ou [Email](#)

[Disponibilidade de anos anteriores, se retorno positivo neste formulário.](#)

[Trabalhos futuros.](#)

## ENEM Interativo

Interativo:

[2019](#)

### ENEM 2019

1. [ENEM 2019 P1 CAD 01 DIA 1 AZUL](#)
2. [ENEM 2019 P1 CAD 02 DIA 1 AMARELO](#)
3. [ENEM 2019 P1 CAD 03 DIA 1 BRANCO](#)
4. [ENEM 2019 P1 CAD 04 DIA 1 ROSA](#)
5. [ENEM 2019 P1 CAD 05 DIA 2 AMARELO](#)
6. [ENEM 2019 P1 CAD 06 DIA 2 CINZA](#)
7. [ENEM 2019 P1 CAD 07 DIA 2 AZUL](#)
8. [ENEM 2019 P1 CAD 08 DIA 2 ROSA](#)
9. [ENEM 2019 P2 CAD 01 DIA 1 AZUL](#)
10. [ENEM 2019 P2 CAD 02 DIA 1 AMARELO](#)
11. [ENEM 2019 P2 CAD 03 DIA 1 BRANCO](#)
12. [ENEM 2019 P2 CAD 04 DIA 1 ROSA](#)
13. [ENEM 2019 P2 CAD 05 DIA 2 AMARELO](#)
14. [ENEM 2019 P2 CAD 06 DIA 2 CINZA](#)
15. [ENEM 2019 P2 CAD 07 DIA 2 AZUL](#)
16. [ENEM 2019 P2 CAD 08 DIA 2 ROSA](#)

[Voltar](#)

Method: **ENEM Interativo** - <http://vision.ufabc.edu.br/MCTest/ENEM>

**ENEM Interativo**

00 :00 :00 :00

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Recarregue essa página, caso não apareçam áreas verdes em cada questão



\* S A O 1 \*

**EXAME NACIONAL DO ENSINO MÉDIO**  
PROVA DE LINGUAGENS, CÓDIGOS E SUAS TECNOLOGIAS E REDAÇÃO  
PROVA DE CIÊNCIAS HUMANAS E SUAS TECNOLOGIAS

**enem2019**

1º DIA  
CADERNO  
**1**  
AZUL



Method: **ENEM Interativo** - <http://vision.ufabc.edu.br/MCTest/ENEM>

**enem2019**

**LINGUAGENS, CÓDIGOS E SUAS TECNOLOGIAS**  
**Questões de 01 a 45**  
**Questões de 01 a 05 (opção inglês)**

**Questão 1**  A  B  C  D  E **Salvar Sempre** 1/90

**5 Ways Pets Can Improve Your Health**

A pet is certainly a great friend. After a difficult day, pet owners quite literally feel the love.  
In fact, for nearly 25 years, research has shown that

**Questão 2**  A  B  C  D  E **Salvar Sempre** 2/90

**LETTER TO THE EDITOR: Sugar fear-mongering unhelpful**  
By The Washington Times Tuesday, June 25, 2013

In his recent piece “Is obesity a disease?” (Web, June 19), Dr. Peter Lind refers to high-fructose corn syrup and other “manufactured sugars” as “poison” that will “guarantee storage of fat in the body.” Current scientific research strongly indicates that obesity results from excessive calorie intake combined with a sedentary lifestyle. The fact is Americans are consuming more total calories now than ever before. According to the U.S. Department of Agriculture, our total per-capita daily caloric intake increased by 22 percent from

LC - 1º dia | Caderno 1 - AZUL - Página 32

**ENEM Interativo**

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**Estatísticas**

Method: **ENEM Interativo** - <http://vision.ufabc.edu.br/MCTest/ENEM>

Imprimir

## ENEM Interativo

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28/06/2021 10:23:20

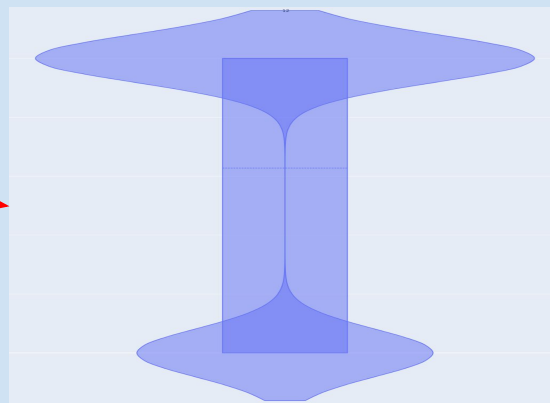
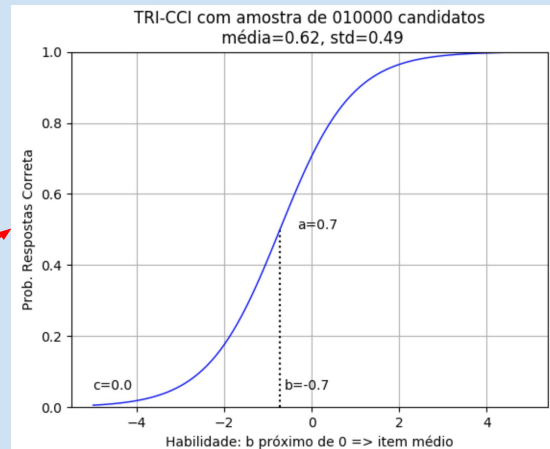
Cor AZUL - Exames: LC,CH

Questões de Inglês: 1, 2, 3, 4, 5

Questões de Espanhol: 01, 02, 03, 04, 05

Os gráficos são dos alunos que escolheram inglês

N.	Correta	Marcada	Habilidade	<a href="#">Estatísticas (TRI)</a>	<a href="#">Estatísticas (boxplot)</a>
1	B		7	<a href="#">TRI</a>	<a href="#">BOX</a>
2	D		7	<a href="#">TRI</a>	<a href="#">BOX</a>
3	A		6	<a href="#">TRI</a>	<a href="#">BOX</a>
4	B		8	<a href="#">TRI</a>	<a href="#">BOX</a>
5	E		5	<a href="#">TRI</a>	<a href="#">BOX</a>
01	A		8		



## Results and Discussion

- The ENEM Interactive service was opened to the public on June 24, 2021, and sent an email to:
  - List of UFABC professors
  - List of the Brazilian Computer Society
  - For the 380 students of the UFABC Preparatory School
- The consolidation of responses to a questionnaire took place after 12 days of service availability



# Results and Discussion

- 56 answers
  - Questions 1 to 6 about usability
  - Questions 8 to 10 about utility

56 respostas	1	2	3	4	5	6	7	8	9	10	11
média	4,57	4,52	4,55	4,63	4,25	4,30	4,64	4,86	4,86	4,84	4,84
std	0,71	0,60	0,76	0,62	0,86	0,91	0,64	0,40	0,40	0,42	0,50
menor	2	3	2	3	2	2	2	3	3	3	2
1o Quartil	4	4	4	4	4	4	4	5	5	5	5
2o Quartil	5	5	5	5	4	5	5	5	5	5	5
3o Quartil	5	5	5	5	5	5	5	5	5	5	5

92.86% approval in usability

and 96.78% approval in utility

# Conclusions

- How to help ENEM candidates?
  - Provision of old exams
  - Provision of templates
  - Provides statistics including Item Response Theory (IRT) - adopted in ENEM
  - Providing an interactive system to assist candidates

⇒ Using ***ENEM Iterativo***, available:

- <http://vision.ufabc.edu.br/MCTest/ENEM>
- <http://mctest.ufabc.edu.br:8000/ENEM>
- <https://github.com/fzampirolli/ENEM>

# Future Work

- Include accessibility
- Estimate each student's ability by area
- Provides exams before 2019
- Create a user registration system to be able to consult a history of previous exams
- Include videos explaining how to solve each question

Thanks!

Questions?

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