SPREADSHEETBENCH

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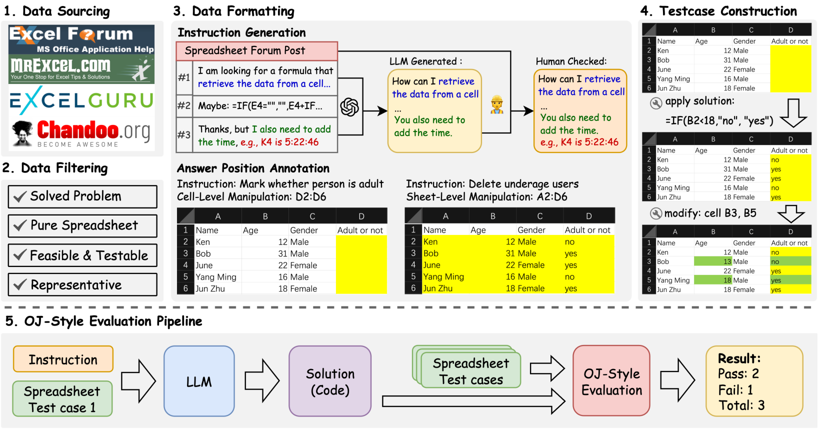
Five Key Ideas

- Collect high-quality **data** from real-world sources and select the questions by rigorous criteria
- Utilize GPT-4 to recreate a coherent **instruction**
- Categorize **answer positions** into sheet-level and cell-level
- Create multiple spreadsheets and develop multiple **test cases** for each instruction
- Use various methods to mitigate **data leakage**



1. Data Sourcing

Excel Forum
MS Office Application Help
MREXCEL.COM
Your One Stop for Excel Tips & Solutions
EXCELGURU
Chandoo.org
BECOME AWESOME

2. Data Filtering

- ✓ Solved Problem
- ✓ Pure Spreadsheet
- ✓ Feasible & Testable
- ✓ Representative

3. Data Formatting

Instruction Generation

Spreadsheet Forum Post

#1	I am looking for a formula that retrieve the data from a cell...
#2	Maybe: =IF(E4="","",E4+IF...
#3	Thanks, but I also need to add the time, e.g., K4 is 5:22:46

LLM Generated :

How can I retrieve the data from a cell
...
You also need to add the time.

Human Checked:

How can I retrieve the data from a cell
...
You also need to add the time.
e.g., K4 is 5:22:46

Answer Position Annotation

Instruction: Mark whether person is adult
Cell-Level Manipulation: D2:D6

	A	B	C	D
1	Name	Age	Gender	Adult or not
2	Ken	12	Male	
3	Bob	31	Male	
4	June	22	Female	
5	Yang Ming	16	Male	
6	Jun Zhu	18	Female	

Instruction: Delete underage users
Sheet-Level Manipulation: A2:D6

	A	B	C	D
1	Name	Age	Gender	Adult or not
2	Ken	12	Male	no
3	Bob	31	Male	yes
4	June	22	Female	yes
5	Yang Ming	16	Male	no
6	Jun Zhu	18	Female	yes

4. Testcase Construction

	A	B	C	D
1	Name	Age	Gender	Adult or not
2	Ken	12	Male	
3	Bob	31	Male	
4	June	22	Female	
5	Yang Ming	16	Male	
6	Jun Zhu	18	Female	

apply solution:

=IF(B2<18,"no", "yes")

	A	B	C	D
1	Name	Age	Gender	Adult or not
2	Ken	12	Male	no
3	Bob	31	Male	yes
4	June	22	Female	yes
5	Yang Ming	16	Male	no
6	Jun Zhu	18	Female	yes

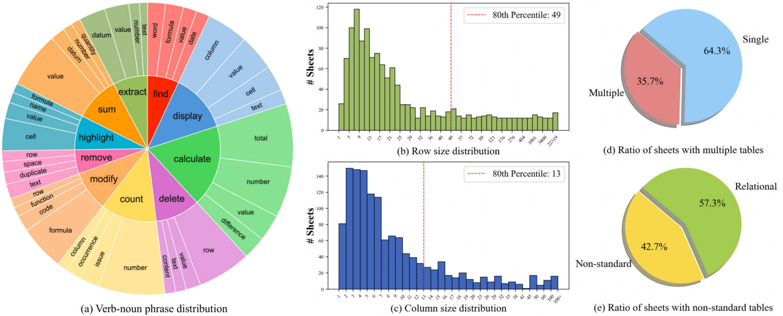
modify: cell B3, B5

	A	B	C	D
1	Name	Age	Gender	Adult or not
2	Ken	12	Male	no
3	Bob	13	Male	no
4	June	22	Female	yes
5	Yang Ming	18	Male	yes
6	Jun Zhu	18	Female	yes

5. OJ-Style Evaluation Pipeline

Figure 1: The benchmark construction pipeline and OJ-style evaluation.

Data Info



(a) Verb-noun phrase distribution

(b) Row size distribution

(c) Column size distribution

(d) Ratio of sheets with multiple tables

(e) Ratio of sheets with non-standard tables

Figure 2: Key statistics of SPREADSHEETBENCH.

Data Leakage

Issue: Datasets initially **obtained from online** forums may be susceptible to data leakage issues, given that many LLMs are pre-trained using a vast corpus of web text.

Solutions:

- **Revise the original questions** in the posts during the Instruction Generation process.
- **modifying the original provided spreadsheets** during the Spreadsheet Modification.
- **alter the position** of the tabular data in the original spreadsheets and the corresponding answer in the resulting spreadsheets during the Answer Position Changing

Evaluation Metrics

- **Soft Restriction:**

$$S_{\text{soft}} = \frac{1}{|D|}\sum_{i=1}^{|D|}\left(\frac{1}{|T_i|}\sum_{j=1}^{|T_i|}1_{r_i=\text{ACC}}\right)$$

- **Hard Restriction:**

$$S_{hard} = \frac{1}{|D|}\sum_{i=1}^{|D|}1_{rij} = ACC, \forall j = 1, 2, \ldots, |T_i|$$

Inference Setting

Evaluate LLMs under two distinct settings:

- **Single-Round:** present the model with the initial few rows of spreadsheet files within the prompt, allowing for **only one inference**.
- **Multi-Round:** Building on the single-round prompt setting, furnish error feedback if the code fails to execute, enabling the model to refine its code in subsequent iterations.

GitHub Link

GitHub Link:
https://github.com/RUCKBReasoning/SpreadsheetBench

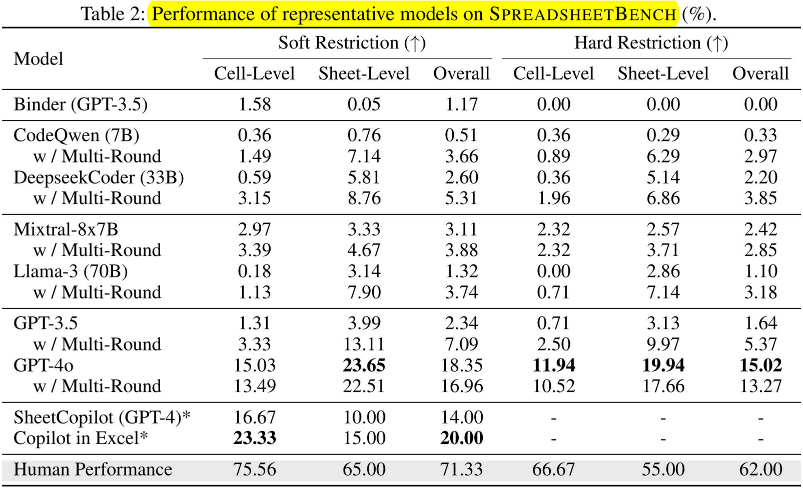
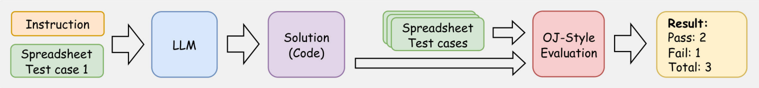


Table 2: Performance of representative models on SPREADSHEETBENCH (%).

Model	Soft Restriction (↑)			Hard Restriction (↑)		
	Cell-Level	Sheet-Level	Overall	Cell-Level	Sheet-Level	Overall
Binder (GPT-3.5)	1.58	0.05	1.17	0.00	0.00	0.00
CodeQwen (7B)	0.36	0.76	0.51	0.36	0.29	0.33
w / Multi-Round	1.49	7.14	3.66	0.89	6.29	2.97
DeepseekCoder (33B)	0.59	5.81	2.60	0.36	5.14	2.20
w / Multi-Round	3.15	8.76	5.31	1.96	6.86	3.85
Mixtral-8x7B	2.97	3.33	3.11	2.32	2.57	2.42
w / Multi-Round	3.39	4.67	3.88	2.32	3.71	2.85
Llama-3 (70B)	0.18	3.14	1.32	0.00	2.86	1.10
w / Multi-Round	1.13	7.90	3.74	0.71	7.14	3.18
GPT-3.5	1.31	3.99	2.34	0.71	3.13	1.64
w / Multi-Round	3.33	13.11	7.09	2.50	9.97	5.37
GPT-4o	15.03	**23.65**	18.35	**11.94**	**19.94**	**15.02**
w / Multi-Round	13.49	22.51	16.96	10.52	17.66	13.27
SheetCopilot (GPT-4)*	16.67	10.00	14.00	-	-	-
Copilot in Excel*	**23.33**	15.00	**20.00**	-	-	-
Human Performance	75.56	65.00	71.33	66.67	55.00	62.00

Figure 3: Performance of representative models on SPREADSHEETBENCH %.

- The concept of constructing a benchmark:
    - Data quality
    - Data construction
    - Data diversity
- Methods to address data leakage issues
- Developing a pipeline for evaluating problems using LLMs



Thanks!