ISSN: 2473-4901
v11 n6406

Teaching Case

Teaching Business Students Critical Thinking Using Data Visualization and ChatGPT

Benjamin Larson
blarson@aum.edu

Jeffrey Bohler
jbohler1@aum.edu

Nadini Bolekar
nbolekar@aum.edu

Auburn University at Montgomery
Montgomery, AL, USA

Hook

Can you trust what AI tells you? This case challenges students to analyze AI outputs and develop critical thinking in data-driven decision-making.

Abstract

Data analytics is essential for business students, and generative AI tools are increasingly integrated into coursework. However, AI outputs can be inconsistent, incomplete, or misleading. This case develops students' critical thinking by challenging them to interact with AI, evaluate assumptions, and refine prompts, applying Robert Ennis' dimensions of critical thinking—logical, critical, and pragmatic. Using a data visualization, students assess linear regression assumptions, identify limitations of AI interpretations, and improve responses with human expertise. Structured rubrics guide assessment of prompt engineering, reasoning, and peer reflection. The case is designed for undergraduate analytics, MIS, and statistics courses, and is adaptable to graduate and professional programs. By comparing outputs, questioning assumptions, and engaging in collaborative reflection, students strengthen technical skills and professional judgment, preparing for workplaces where AI augments rather than replaces human decision-making. The assignment yields measurable outcomes: students critically evaluate AI-generated responses using structured rubrics, construct and refine effective prompts, and engage in peer reflection to enhance their reasoning and communication. The activity is well-suited for undergraduate analytics, MIS, or statistics courses, and at the graduate level for AI, analytics, or MBA decision-making contexts. It can also be adapted for professional education and interdisciplinary programs to build AI literacy. By comparing responses, questioning assumptions, and reflecting with peers, students strengthen both technical skills and professional judgment, preparing them for a future where AI augments rather than replaces human decision-making.

Keywords: Critical Thinking, Generative AI in teaching, Data Analytics, Data Visualization, Prompt Engineering, CRISP-DM

ISSN: 2473-4901
v11 n6406

Teaching Business Students Critical Thinking Using Data Visualization and ChatGPT

Benjamin Larson, Jeffrey Bohler, and Nadini Bolekar

1. INTRODUCTION

Utilizing data to make informed decisions is essential for most modern businesses. It can require a wide range of technical skills (Collier & Powell, 2024). Making the connection between details and higher-level concepts requires education and practice (Holmes, Bialik, & Fadel, 2019). However, there is a shift towards low- and no-code solutions that enable a wider range of students to tackle more technical challenges, such as machine learning (Sundberg & Holmström, 2024). Generative AI is making many complex processes more straightforward, and we may see a future where most code and programs are generated through prompts using natural language, as well as multimodal inputs such as images, audio, or video. If this is the case, then an emphasis needs to be placed on critical thinking and problem-solving when using AI (Kasneci et al., 2023). Akhtar (2025) and many others argue that careers are less likely to be replaced by AI itself, but rather by individuals who effectively leverage AI tools, in other words, AI literate. This highlights the importance of exposure to AI while enhancing "people" skills (Gonzalez, 2023). Ultimately, generative AI can serve as a critical component in scaffolding, enabling students to tackle complex problems. This case may allow students to practice this skill by applying scaffolding to the Data Exploration step of the Data Understanding phase of the CRISP-DM framework. However, students still need to evaluate AI responses for relevance and accuracy.

2. CASE SUMMARY

This assignment is a critical thinking exercise that also encourages students to interact with generative AI during either the Data Understanding or Data Preparation phase of the Cross-Industry Standard Process for Data Mining (CRISP-DM) or similar process phases in other machine learning or data mining models. Using Robert Ennis' three dimensions of critical thinking (logical, criterial, and pragmatic) (Ennis, R., 1962), it may also be delivered as an introductory assignment that encourages the use of generative AI in the course while discussing its limitations. The students need to have sufficient knowledge to evaluate the critical dimension of the response and enough confidence in themselves to override the AI tool's response.

Data visualizations are a popular tool to evaluate the relationships between variables in data. In this case, the students will upload an image that explores the relationship between years of service and wages for two positions at a fictitious company. Specifically, they will evaluate whether the relationship between years of service and wages is linear, which is an assumption of linear regression.

The visualization presented (Figure 1) is not intended to blatantly violate the linearity assumption, but rather to indicate that the relationship may be changing. This is something that not all AI models may pick up on, given a small number of records. However, when combined with a user who critically evaluates the visualization with knowledge related to problems and model assumptions, there is potential to improve the model by engineering features based on business principles rather than attempting to create the best fit, which may lead to overfitting a model. Within the figure, Position 1 Wages become non-linear between Year 6 and 7. This would violate the linearity required for a linear regression and should be taken into consideration. Position 1 represents workers, and Position 2 represents supervisors, both of whom are paid wages based on an hourly rate.

AI will also not necessarily provide consistent responses to similar prompts, which can cause an AI divide in the classroom, as students who have previously worked with AI on similar problems may receive better responses to their prompts. By interacting with other students to discuss their results, the students will also discover the need to train their model appropriately and to improve their ability to prompt AI to receive appropriate responses. To help facilitate this, they will be given a series of prompts to gauge the performance of their generative AI.

The objective of the case is to develop critical thinking skills by interacting with AI, analyzing responses, and questioning assumptions in data interpretation. Students will also gain knowledge

ISSN: 2473-4901
v11 n6406

in generating AI responses and critically evaluate their accuracy, biases, and limitations. Finally, through interactions with their classmates, they will also evaluate if their models are similarly trained and learn the importance of training their models to improve future results.

To maximize the pedagogical impact of this AI-enhanced critical thinking exercise, instructors should establish clear evaluation criteria that assess both technical competency and analytical reasoning. Students benefit from structured rubrics that evaluate their ability to craft effective prompts, critically assess AI-generated interpretations, and identify when generative AI fails to recognize subtle patterns in data visualization.

The assignment's success hinges on creating collaborative learning environments where students compare AI responses and discover inconsistencies, fostering discussions about model training variations and the importance of human expertise in validating AI conclusions. By incorporating peer review sessions and reflective components, educators can ensure students develop not only technical skills in AI interaction but also the professional judgment necessary to leverage these tools effectively in real-world business contexts, ultimately preparing them for a future where AI augments rather than replaces human decision-making capabilities.

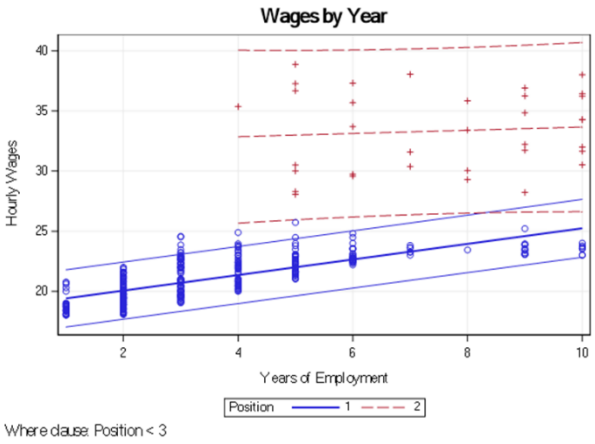

Figure 1: Wages by Year Visualization

3. CRISP-DM

The data analysis process employed in this case is based on the widely used Cross-Industry Standard Process for Data Mining (CRISP-DM) (IBM, n.d. -a) cycle framework, which comprises six phases: business understanding, data understanding, data preparation, modeling, and deployment (Wirth & Hipp, 2000), see Figure 2.

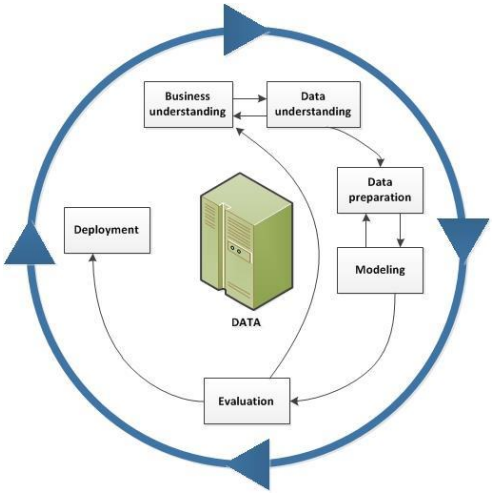

Figure 2: CRISP(DM) Data Mining Life Cycle

Business Understanding defines the project objectives and requirements from a business perspective, converting them into a data mining problem definition that includes project management, situational assessment, and identification of business assumptions. A key assumption of the business in this case may be that for some positions, there may be a rapid rise to equitable compensation early on, leading to lower salary increases once an employee has established seniority.

During the data understanding phase, the team collects initial data, describes its characteristics, and explores it to identify data quality issues, patterns, or initial hypotheses. In this phase, we may evaluate assumptions, such as linearity among the variables, to determine if a model is appropriate or if feature engineering is required. The case study is a part of the Data Understanding phase of CRISP-DM. The results are included as part of the example memo for the larger case used in the class. In this case, it may be appropriate to engineer a feature that maximizes the influence of years of service. This may be something discovered at this phase, but it would be more appropriate to note it as a business assumption in the prior phase. The exploration should then lead to action in the Data Preparation phase.

In the Data Preparation phase, the team selects, cleans, engineers features, and formats the data into a form suitable for modeling. In this case, the decision may be made to manufacture a feature that caps the years of service used in the linear

model.

Modeling involves selecting and applying various modeling techniques. These techniques include adjusting model parameters and evaluating the performance of each model to determine its effectiveness.

Evaluation is the process of reviewing the model results to ensure they meet business objectives and determine if additional steps or revisions are needed. In this case, the students would likely create a model that caps the years of service and then evaluate if this improves the model fit.

Deployment is the phase that delivers the results, including reports, dashboards, or integrated models or systems, into the business environment. In this case, a model can be created to establish a statistical control of employee salaries, which can be implemented to determine if employees are being paid equitably.

Each phase is meant to have a relationship with the other phases; however, this connection can be lost on students without providing examples. This case serves as an example, as the business understanding provides the goals of the business and the project, while also assessing the situation, which can include listing assumptions.

In this case, the assumption is that employee salaries for certain positions may rise earlier in an employee's tenure and then stabilize. The need to engineer a feature should be noted during the data understanding phase, as the data is explored, which then occurs in the data preparation phase, and is modeled and assessed in the subsequent phases.

4. AI Response Evaluation

Information systems education should incorporate AI into our courses, including allowing students to utilize AI in projects to enhance their learning (Zhang, 2025). By having students prompt AI in various ways to understand its limitations, they will develop skills essential in the modern workplace. Prompt engineering is the writing of prompts in a way that enables you to get the desired results from AI. The more knowledgeable students are about the context of the problem and the terminology, the more effective they will be in evaluating AI responses and adjusting their prompts. However, not all students will start at the same point with their AI. Different out-of-the-box models may yield different results or have been modified by the individual user through training. This represents one or more "shots of training" of the model by the individual student. In this way, the model may be improved to provide better results (Li et al., 2023).

For users who lack the knowledge or experience to create fully developed prompts, conversational prompting may be a more suitable approach (Ein-Dor et al., 2024). This allows students to prompt AI by engaging in a natural conversation about a topic, rather than structuring a formal prompt. This allows AI to help provide scaffolding on individual concepts, as the students may focus on one area of a complicated problem rather than creating a complex prompt. Here, having a conversation with AI about the relationships between a few variables and whether they meet an assumption would allow students to understand a smaller section of the analysis, rather than evaluating the whole process and model at once. This can be combined with a chain of thought prompts, which require the user to try to understand the reasoning or train of thought that leads the model to make its response (IBM, n.d. -b; PromptingGuide.ai, 2025; Mitra et al., 2024).

Another trend in AI prompting is that it is becoming multimodal, allowing for images and other media formats as well as text to be used in prompts (Mitra et al., 2024). Utilizing visualizations in prompts and discussing the results in conversations with AI will provide personalized scaffolding that instructors would not otherwise be able to provide easily. However, it is something that the instructor needs to monitor, as prompt responses will not be consistent if they are too complicated and/or the prompters have differences in the models that they are using.

By having assignments that prompt discussions of their results, students may become aware of potential limitations as their prompts become more complex. It will also help to train models that are less developed, especially if students have different levels of exposure to statistics and/or AI usage. Students can use reflective learning using AI. Reflective learning using AI refers to the process by which learners *critically assess* their experiences, decision-making processes, emotions, outcomes, and assumptions with the support of AI tools (such as large language models or generative AI), enabling them to identify strengths and weaknesses, deepen self-awareness, and improve future

ISSN: 2473-4901
v11 n6406

performance (Yuan & Hu, 2024).

5. Case Setup

The case presents a novel approach that enables students to interact with AI and with one another in the classroom. In this way, it promotes the use of novel technology, develops critical thinking skills, and helps build a learning community in the classroom. The case can be used as an initial icebreaker in the classroom to promote interaction that can also be discussed as the class progresses. Alternatively, the case may be used during one of the appropriate phases in the analytical process that the course utilizes, such as the data understanding phase of CRISP-DM.

The students should be made aware, prior to the assignment, that some positions may experience a rapidly flattening curve for wage increases and that the assumption of linear regression is based on a linear relationship between the dependent and independent variables. In this case, the dependent variable would be wages, and we want the AI to recognize that the relationship between years of employment and wages flattens between six and seven years of employment.

Students should be directed to use a generative AI tool, such as ChatGPT or Copilot, and to prompt the AI as detailed below. Between each prompt, students should discuss the appropriate discussion question within a small group. Alternatively, suppose the student is in an online course. In that case, they should be directed to save their responses and respond to each question within a post, allowing the rest of the class to see and respond if they received similar results. Critical Thinking tasks are abbreviated as CT in the following list of prompts.

Prompt 0: Upload the image with no additional comments.

Discussion Question 0.1 Did AI provide an adequate description of what the image was (CT – Pragmatic)?

Discussion Question 0.2 - Did AI note any change in the relationship of wages and years of employment for position 1 (CT – Logical)?

Prompt 1: Do the years of employment appear to have a linear relationship with wages?

Discussion Question 1.1 - Did AI note that the relationship was linear (CT – Logical)?

Discussion Question 1.2 - Did AI note any caution related to Position 1 having a changing relationship? If caution was noted, what was its chain of thought? Make an argument about whether the chain of thought is appropriate if provided (CT Pragmatic & Criterial).

Discussion Question 1.3 - Evaluate whether additional prompting is needed to elicit the model's reasoning process and justify your decision (CT Pragmatic & Criterial).

Prompt 2: Are you concerned about the values after year six being below the regression line?

Discussion Question 2.1 - Did AI note that there is a concern that the relationship may be changing (CT Logical)?

Discussion Question 2.2 - Did AI provide a reason why the relationship may be changing? If yes, what was it (CT Logical)?

Discussion Question 2.3 - Did AI provide a reason why the results may still be linear? If yes, what was it (CT Logical)?

Discussion Question 2.4 - Explain whether you agree with the AI and why (CT Pragmatic & Criterial).

Prompt 3: Would it make sense to cap the years of employment at seven? Why or why not?

Discussion Question 3.1 **-** Did AI provide a recommendation? If yes, what was it (CT Logical)?

Discussion Question 3.2 - Did AI provide a justification? If yes, what was it (CT Logical)?

Discussion Question 3.3 Did AI provide alternatives? If yes, what were they (CT Logical)?

Discussion Question 3.4 - Make an argument as to why you would agree or disagree with the recommendation (CT Pragmatic & Criterial).

Prompt 4: What formula would I use in Excel to generate a variable with a maximum of seven years?

Discussion Question 4.1 - Did AI provide the correct formula (CT Criterial)?

Discussion Question 4.2 - How would you describe the value of AI and the human operator in this process (CT Logical, Criterial, and Pragmatic)?

6. CONCLUSIONS

This case provides a practical yet straightforward example that connects the phases of CRISP-DM while simultaneously allowing students to explore multimodal prompting of AI. With current levels

of AI, students should also be aware of inconsistencies in the responses provided by generative AI. The case mainly received positive feedback from students for its simplicity in execution, while providing a relevant discussion topic. For many, the change in the relationship between wages and years of employment would not have been apparent at all. This should leave students feeling that they need to critically analyze the output of AI to add value to the analysis that they are asked to perform.

7. REFERENCES

Akhtar, R. (2025, March 27). *AI won't replace you. A human using AI will*. *Forbes*. Retrieved August 15, 2025, from https://www.forbes.com/sites/reeceakhtar/2025/03/27/ai-wont-replace-you-a-human-using-ai-will/

Collier, C. A., & Powell, A. L. (2024). Data Analyst Competencies: A Theory-Driven Investigation of Industry Requirements in the Field of Data Analytics. *Journal of Information Systems Education*, 35(3), 325-376. https://doi.org/10.62273/SPYC4248

Ein-Dor, L., Toledo-Ronen, O., Spector, A., Gretz, S., Dankin, L., Halfon, A., & Slonim, N. (2024). Conversational prompt engineering. arXiv preprint arXiv:2408.04560. https://doi.org/10.48550/arXiv.2408.04560

Ennis, R. H. (1962). *A concept of critical thinking* (p. 84). Harvard Educational Review.

Gonzalez, A. (2023, August 22). *IBM study: AI won't replace people, people who use AI will replace people who don't*. *Going Concern*. Retrieved August 15, 2025, from https://www.goingconcern.com/ibm-study-ai-wont-replace-people-people-who-use-ai-will-replace-people-who-dont/

Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial Intelligence in Education: Promises and Implications for Teaching and Learning.* Boston: Center for Curriculum Redesign.

IBM. (n.d.-a). Modeling. In IBM SPSS Modeler SaaS documentation. Retrieved August 15, 2025, from https://www.ibm.com/docs/en/spss-modeler/saas?topic=guide-modeling

IBM. (n.d.-b). What is chain of thought (CoT) prompting? IBM Think. Retrieved August 15, 2025, from https://www.ibm.com/think/topics/chain-of-thoughts

Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groß, C., Günnemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Larissa, N., Schlag, B., & Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences, 103,* 102274. https://doi.org/10.1016/j.lindif.2023.102274

Li, Y., Hui, B., Xia, X., Yang, J., Yang, M., Zhang, L., & Li, Y. (2023). One-shot learning as instruction data prospector for large language models. arXiv preprint arXiv:2312.10302. https://doi.org/10.48550/arXiv.2312.10302

Mitra, C., Huang, B., Darrell, T., & Herzig, R. (2024). *Compositional chain-of-thought prompting for large multimodal models.* In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (pp. 14420–14431). IEEE. https://doi.org/10.1109/CVPR.2024.01445

PromptingGuide.ai. (2025, July 5). *Chain-of-Thought (CoT) prompting*. Retrieved August 15, 2025, from https://www.promptingguide.ai/techniques/cot

Sundberg, L., & Holmström, J. (2024). Teaching Tip: Using No-Code AI to Teach Machine Learning in Higher Education. *Journal of Information Systems Education,* 35(1), 56-66. https://doi.org/10.62273/CYPL2902

Wirth, R., & Hipp, J. (2000, April). CRISP-DM: *Towards a standard process model for data mining.* In Proceedings of the 4th International Conference on the Practical Applications of Knowledge Discovery and Data Mining (Vol. 1, pp. 29–39).

Yuan, B., & Hu, J. (2024, November 19). *Generative AI as a tool for enhancing reflective learning in students* [Preprint]. arXiv. https://doi.org/10.48550/arXiv.2412.02603

Zhang, X. (2025). Teaching Tip: Incorporating AI Tools Into Database Classes. *Journal of Information Systems Education,* 36(1), 37–52. https://doi.org/10.62273/GKZI247