Engage, Reflect, Improve: Enhancing Statistical Consulting Courses with AI Simulations

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Abstract

This paper describes an AI-infused simulation designed to enhance graduate-level statistical consulting education by bridging theoretical learning with realistic professional practice. Piloted in a master's-level capstone course, the simulation engaged students in consultations with an AI client, requiring them to practice communication, problem framing, methodological justification, and decision-making under authentic conditions. Evidence drawn from interaction transcripts and student reflections showed growth in consulting skills and technical confidence, alongside challenges such as an overly knowledgeable AI client, conversational limitations, and ethical questions raised by participants. The paper details the simulation's structure, instructional integration, and evaluation, offering a model that can be adapted across graduate statistics curricula to strengthen students' preparation for professional practice.

Keywords: Artificial Intelligence, Education, Ethics in AI, Statistical Consulting, Professional Development.

1 Introduction

1.1 AI in Higher Education and Simulation-Based Learning

The educational landscape is undergoing a profound transformation as artificial intelligence (AI) technologies rapidly evolve from peripheral tools to central components of learning environments. This revolution is particularly significant for mathematics and statistics education, where AI can simultaneously serve as both a subject matter and a pedagogical medium. Holmes & Porayska-Pomsta (2022) note that AI technologies are reshaping students' interaction with quantitative ideas, offering unique opportunities to tailor education to individual needs while raising important considerations about practical use and evaluation. Integrating AI into educational contexts represents a "paradigm shift" that fundamentally transforms the way mathematical and statistical knowledge is constructed, communicated, and applied (Du Boulay et al., 2023).

Recent research underscores the transformative potential of AI-enhanced learning experiences. Lee et al. (2024) argue that integrating AI technologies can create more engaging, responsive, and personalized educational environments, preparing students for the increasing AI-mediated professional landscapes. Zawacki-Richter et al. (2019) identify simulation-based learning as a promising application of AI in higher education, particularly for developing professional skills. Our approach aligns with these findings, using AI simulations to provide authentic yet controlled practice that cultivates both technical and interpersonal competencies.

1.2 The Communication Challenge in Statistics Consulting

Effective communication with non-statisticians is essential, yet many statisticians leave formal education without adequate training in this area. Love (2016) highlights that this gap can hinder collaboration and client satisfaction. Statistical consulting requires a blend of technical expertise and interpersonal skills that traditional curricula often fail to develop comprehensively. Graduate-level statistics programs excel at building mythological foundations, but often lack opportunities for students to experience professional consultation complexities, such as communicating with nonspecialists, handling ambiguous problems, responding to feedback, and navigating ethical issues. This gap leaves many graduates unprepared for the human aspects of their roles, a challenge that AI can uniquely address. Integrating AI into educational contexts can bridge this gap, equipping students with the skills needed to thrive in professional environments. This study addresses this persistent challenge by equipping students with the communication and problem-solving skills essential for modern statistical consulting through an AI-infused simulation embedded in graduate coursework.

At California State University Fullerton, the Master of Science Degree in Statistics culminates in a capstone course where students apply their knowledge through consulting engagements with various industry partners and governmental agencies. These engagements offer valuable opportunities for applied practice, but they also have limitations. Client projects vary unpredictably, and the consequences of mistakes can be high, which constrains students' freedom to experiment and explore ideas on their own. As a result, graduates can leave programs with strong technical knowledge, but insufficient preparation for the human aspects of consulting.

1.3 Our Approach

To address these challenges, we introduced an AI-driven client interaction simulation activity. We designed a custom AI bot that emulates clients with varying statistical literacy and professional backgrounds, creating a dynamic learning environment where students can practice essential consulting skills. This approach reflects the idea of "humans and robots working collaboratively" (p.703) in education, where technology functions as an interactive agent that prompts reflection, adaptation, and skill development (Timms, 2016). Our AI-driven simulation bridges the gap between theoretical understanding and practical application, as Kholid et al. (2023) highlighted.

Our intervention has four stages: client needs assessment, proposal development, responsive refinement, and pricing negotiation. These stages mirror the arc of authentic consulting engagements, while introducing intentional challenges that build critical competencies. Students learn to extract clear project parameters from ambiguous client descriptions, translate practical problems into statistical frameworks, make improvements based on client feedback, and articulate the value of their expertise during pricing discussions. The AI-driven simulation fosters critical thinking, adaptability, and negotiation skills essential for professional consulting by simulating real-world pressure in a safe learning environment.

This educational innovation fosters collaboration between humans and AI, promoting ethical awareness in data analysis, ensuring inclusion through various client personas, empowering students with enhanced creative and analytical capabilities, and deepening understanding through structured reflection (Techonology Education Alliance, nd). These principles are designed to guide the integration of AI in education, emphasizing its role as a collaborative partner rather than just a tool. Our approach also aligns with the discussion by Knox et al. (2019) on how AI can enhance human agency and critical thinking, which fits within the concept of empowerment in educational contexts. By creating simulated consulting scenarios that mirror the ethical complexities and communication challenges of real-world engagements, we prepare students for technical problem-solving and responsible professional practice.

1.4 Broader Implications and Contribution

Our work speaks to the broader professional landscape in which statisticians are increasingly operating. McKinsey's report, "Superagency in the Workplace: Empowering People to Unlock AI's Full Potential" (Mayer et al., 2025), highlights AI's transformative potential, comparable to the steam engine during the Industrial Revolution. This underscores the need for professionals to master technical skills and effectively communicate with diverse stakeholders in data-intensive fields. Embedding AI-driven simulations into graduate curricula addresses this need by preparing students to navigate data-intensive, AI-mediated workplaces with confidence.

Although our initial implementation targets graduate students in statistics, the activity has broader applicability. With appropriate adjustments to client scenarios and task complexity, AI-driven simulations can support learning at all educational levels. For undergraduates, simplified client interactions can introduce the core ideas of data communication and ethical awareness. At the graduate level, more nuanced scenarios can cultivate consulting competencies in authentic detail. In professional development settings, advanced simulations can provide continuing education for practitioners seeking to refine communication and negotiation skills in rapidly evolving workplaces.

This paper contributes to the growing discourse on AI in mathematics and statistics education by presenting a replicable model of AI-driven consulting simulations. Rather than describing AI as merely a tool for efficiency, we highlight its potential to promote metacognitive awareness, communication, and ethical reasoning (Kasneci et al., 2023). Our experience offers insights for educators designing curricula that integrate AI thoughtfully, demonstrating how simulations can extend classroom learning into authentic professional preparation.

2 Activity Description

This section describes the AI-driven consulting simulation in the Statistical Consulting class. It provides a realistic and structured experience similar to real-world consulting, using a custom AI bot to simulate client interactions and improve students' communication and problem-solving skills.

This simulation does not require programming, custom Flask apps, or specialized integration into Canvas. The "bot" is a custom ChatGPT created entirely using prompt-based instructions, which we provide in Appendix B. Any instructor or practitioner can reproduce the bot by pasting these instructions into a custom GPT builder (or adapting them to other generative AI platforms), making the activity easily transferable across courses and institutions without additional technical infrastructure. Students interacted with the bot using the free ChatGPT voice interface, ensuring accessibility without added cost or setup. The AI client is not proprietary to our program; rather, it is a flexible template that can be recreated or modified for different teaching or training contexts. Because generative AI tools evolve rapidly, we recommend revisiting and updating the instructions as needed to maintain alignment with current platforms.

2.1 Overview of the Simulation

The activity places students in a realistic consulting scenario with an AI bot acting as a demanding client. It progresses through four stages, from needs assessment to pricing negotiation, ensuring that students experience each key phase of consulting and reinforce core learning objectives (see Appendix A).

2.2 Structure and Stages

The simulation is divided into four sequential stages:

1. Understanding client needs: The session begins when the student initiates the interaction with the trigger phrase "Start the meeting." The AI bot, adopting the persona of a seasoned client, introduces a project scenario and expects the student to ask clarifying questions to delineate the project's scope and constraints.

2. Statistical proposal: Once the project needs are clear, the student outlines a comprehensive methodological approach. This stage requires the student to frame the statistical problem, propose appropriate methodologies, and anticipate potential challenges, such as data limitations or ethical issues.

3. Feedback and revision: In response to the student's proposal, the AI bot provides critical feedback, challenging assumptions, and prompting refinements. This iterative process is essential to foster adaptability and ensure that the final project plan is actionable and aligned with client expectations.

4. Pricing discussion: The final stage involves negotiating the consulting fee. Students must justify the pricing structure by articulating the value of their proposed solution, addressing budget constraints, and, where necessary, adjusting the scope of work to fit financial parameters.

2.3 Integration with Course Content and Learning Objectives

Prior to the simulation, students review case studies and course materials that underscore the principles of statistical consulting. The activity is explicitly designed to meet several learning objectives:

- Enhancing professional communication and client engagement skills.
- Developing the ability to identify and frame statistical challenges based on real-world data contexts.
- Practicing adaptive problem-solving in response to dynamic client feedback.
- Refining negotiation techniques, particularly in justifying pricing structures.

The simulation itself emphasizes problem formulation, methodological justification, and professional communication rather than live data analysis during the session. Students are expected to articulate how they would implement analyses (e.g., model specification, validation strategy, data preprocessing), but the bot interaction does not require coding or real-time computation. Implementation occurs separately within the broader capstone consulting projects in which students analyze authentic datasets for external partners. Thus, the AI simulation is intentionally positioned as a structured rehearsal of the early and middle phases of the statistical problem-solving process, particularly problem formulation, model justification, and client communication.

2.4 Technical Implementation and AI Bot Training

The fidelity of the simulation is underpinned by the robust training of the AI bot. Detailed training instructions ensured that the bot embodied a critical, results-driven client persona capable of challenging students in a manner consistent with professional consulting scenarios. This training, outlined in Appendix B, is key to delivering a consistent and authentic interactive experience.

2.5 Step-by-Step Guide to Creating the AI Client

To support replication, we provide a detailed guide describing how the consulting simulator was created. Although interface layouts may evolve, the core steps remain consistent across generative AI platforms that support persistent system-level instructions.

1. **Access the platform.**

   We used OpenAI's Custom GPT builder within ChatGPT. At the time of writing, it is accessible at: https://chat.openai.com. After logging in:

   - Click on your profile icon (typically located in the upper-right corner).
   - Select *"My GPTs"* or *"Explore GPTs."*
   - Click *"Create a GPT."*

   Note on Platform Updates: Generative AI platforms are updated frequently. Button names, menu locations, or layout may change slightly over time. If terminology differs (e.g., *"Save"* instead of *"Update"*), select the functionally equivalent option. The overall creation process remains the same.

   Additional Resources: Instructors who wish to deepen their understanding of generative AI tools in education may consult OpenAI Academy, which provides tutorials, implementation guides, and best-practice resources: https://academy.openai.com. The Academy includes short courses and practical documentation that can support faculty exploring custom GPT design, AI literacy, and responsible classroom integration.

2. **Create and configure the GPT.**

   After selecting *"Create a GPT,"* you will typically see two panels: a conversational builder and a configuration panel. Select the *"Configure"* tab to directly edit the system-level instructions. In this panel, you may set:

   - The bot's **Name** (visible to students),
   - An optional **Profile Image**,
   - The persistent **Instructions** (the behavioral core of the bot),
   - Optional **Conversation Starters**,
   - Optional **Knowledge** files (see below).

3. **Paste the training instructions.**

   - Copy the complete training script provided in Appendix B.
   - Paste it into the *"Instructions"* field.
   - Ensure the trigger phrase *"Start the meeting"* appears exactly as written.

   The *Instructions* field functions as the bot's system prompt. It defines the persona, structure, evaluation criteria, and behavioral constraints. Everything entered here will guide how the AI behaves in every session.

   Important: After making any change to the Instructions field, click *"Save," "Create,"* or *"Update"* (depending on the interface version). Edits are not applied until this button is pressed. Many unexpected behaviors during testing stem from forgetting to update the configuration after editing.

4. **Optional: Using the "Knowledge" feature.**

   Most GPT builders include a *"Knowledge"* or *"Files"* section where instructors may upload documents that the bot will consult before relying on its general training. Examples include:

   - A syllabus,
   - A grading rubric,
   - Sample project proposals,
   - A question bank,
   - Industry-specific case summaries.

Uploaded files function as a structured reference base. The bot searches these materials when generating responses. For best results:

- Upload concise, high-quality documents.
- Prefer PDF format over slide decks.
- Avoid uploading irrelevant administrative content.

In our implementation, we left the Knowledge section empty to preserve portability. However, instructors may customize the experience by uploading course-specific materials.

5. **Test the bot carefully.**

   Before sharing the bot with students:

   - Confirm that the bot remains inactive until the trigger phrase is used.
   - Type "Start the meeting."
   - Verify that all stages unfold in sequence.
   - Confirm that evaluation feedback appears at the end.

   During testing, instructors should deliberately try:

   - Strong, well-structured responses,
   - Weak or incomplete responses,
   - Off-topic answers,
   - Attempts to skip stages.

   This stress-testing helps reveal whether the instructions produce stable and pedagogically aligned behavior.

6. **Iterate and refine if needed.**

   If the bot's behavior does not align with instructional goals (e.g., tone too informal, stages skipped, feedback inconsistent), instructors may revise the Instructions field.

   However, caution is warranted. Even small wording changes in system-level instructions can significantly alter the model's behavior. Generative models interpret instructions probabilistically; adding, removing, or rephrasing a single sentence may affect tone, structure, or stage transitions. We therefore recommend:

   - Making small, targeted changes,
   - Updating the bot after each change,
   - Re-testing immediately,
   - Avoiding large rewrites unless necessary.

   Instruction refinement should be viewed as an iterative design process rather than a one-time configuration step.

7. **Publish and share.**

   Once testing is complete:

   - Click *"Publish"* or *"Share."*
   - Select appropriate visibility settings.
   - Generate a shareable link.
   - Post the link in your learning management system.

   No programming, API configuration, or learning-management-system integration is required.

2.6 Instructions for Participants and Alternative Options

Students receive a clear set of instructions detailing how to engage with the AI bot, including practical tips for initiating the session and navigating each simulation stage (see Appendix C). Recognizing that some students may have ethical or data privacy concerns regarding AI-based activities, alternative options are provided. These include an industry research project, client communication workshops, and peer-driven consulting simulations, ensuring that all students have access to an enriching learning experience without compromising their ethical stances (see Appendix E).

2.7 Student Feedback and Evaluation

Following the simulation, students complete a structured feedback process. They respond to open-ended questions that assess the realism of the simulation, identify any challenges encountered, and evaluate the overall impact of the activity on their consulting skills (see Appendix D). This feedback, collected under IRB-approved consent procedures, serves as the primary data source for this study and is instrumental for iterative improvements, ensuring that the simulation remains aligned with educational objectives and the evolving demands of professional consulting.

3 Discussion

Integrating AI-driven client simulations into the Statistical Consulting course created a novel avenue for students to hone their professional skills in a realistic yet controlled setting. In line with previous research on statistical consulting pedagogy (Taplin, 2007; Sima et al., 2020; Kaseda et al., 2022; Niu, 2022; Shilane & Zirkel, 2022; Sharifi-Far & Jaafar, 2023), the AI-based role-play engaged students in realistic problem-solving and communication, bridging the gap between classroom theory and real-world practice. By analyzing student–AI interaction transcripts and reviewing student feedback, we identified key strengths of this pedagogical approach and areas for improvement. In the following subsections, we discuss the nature of student–AI dialogues, common mistakes, limitations of the AI client, insights from student reflections, and broader implications for statistics education.

3.1 Analysis of Student–AI Conversations and Quality of Statistical Discussions

The simulated consultations, in which the AI bot adopted the persona of a critical client ("Adam Teller"), revealed consistent patterns in how students initiated and navigated their client meetings. Most of the students started appropriately with professional introductions. In this initial stage, students focused on understanding the client's needs, routinely asking clarifying questions about the business problem, available data, and the client's objectives. This mirrors best practices in consulting, where the first step is thorough formulation of the problem and collection of context (Taplin, 2007). As one student remarked:

> "This GPT is a pretty useful in getting to know what kinds of questions I can expect from a client, as well as the feedback I will receive from a certain response."

This emphasis on asking the right questions aligns with the course's goal of developing strong communication and client engagement skills. In subsequent stages, students proposed a range of statistical methodologies tailored to the problem described by the client. Common suggestions included techniques such as clustering analyses, A/B testing for marketing optimization, time series forecasting (e.g., SARIMAX models for sales), and classification methods (logistic regression or random forests for customer churn). Many students demonstrated strong judgment when selecting appropriate methods independently. Others found the AI bot's input especially valuable, prompting reflection on

their own statistical knowledge and consulting presence. One student captured this dual effect, both the bot's instructional value and the challenge it posed to student agency:

> "The bot demonstrated a strong understanding of statistical models, clearly explaining when and in what situations to use different techniques. This was helpful in guiding the conversation toward a structured approach for data analysis. However, because the bot was so knowledgeable, I sometimes felt like it was leading the conversation rather than allowing me to take charge as the consultant. While this made it easier to follow along, it also made me realize that as a consultant, I need to be more proactive in driving the discussion."

This reflection highlights a key pedagogical insight: AI not only reinforces technical knowledge, but also reveals gaps in consulting confidence and initiative, critical skills for real-world practice.

In addition, the depth of the technical discussions varied among students. Some provided detailed justifications for their choices and discussed potential challenges (such as data limitations or model interpretability), whereas others remained at a broader, less specific level. In several instances, the AI "client" prompted students to elaborate further, such as pressing for how external factors might be accounted for or asking for clarification on proposed approaches. This iterative back-and-forth effectively nurtured adaptive problem solving and critical thinking as students had to refine their real-life explanations. In general, the dialogue transcripts suggest that the simulation successfully engaged the students in a consulting-style conversation, reinforcing their statistical reasoning and the ability to communicate under pressure.

3.2 Common Student Mistakes and Misconceptions

Despite the generally high level of performance, specific recurring issues emerged. In particular, some students were less proactive about situating their analysis within the broader business context. For example, although most inquired about the details of the data, some overlooked asking about the client's overarching business goals or larger-picture objectives. One student reflected on this oversight:

> "For example, when I asked about the data, I should have asked about the business goals."

This observation underscores the importance of embedding technical problem-solving in a wider strategic framework. Experienced statisticians emphasize that successful consulting begins with understanding the real needs and goals of the client, not just the data (ASA Consulting Section, n.d.; Cabrera & McDougall, 2002). Our findings echo this sentiment: Students must learn first to ask, 'Why does this problem matter for the client?' before diving into 'How do I analyze the data?'

Another area of difficulty was communicating complex concepts in an accessible language. Although students generally displayed competent statistical knowledge, several struggled to explain technical ideas without jargon. Some of their initial responses were overly laden with statistical terminology and lacked sufficient simplification for a non-specialist audience. This was echoed in the bot's feedback to one student, which highlighted the need for greater attention to usability and audience accessibility:

> "**Usability Consideration:** You adapted well when I brought it up, but initially, the deliverable sounded too technical for my team. Keep the end-user in mind from the start."

This quote highlights the need to tailor communication to the client's level of statistical literacy, a core consulting skill often cited in the literature (Derr, 2000; Cabrera & McDougall, 2002; Moolman, 2010).

The simulation revealed that some students needed more practice translating technical results into business insights for lay stakeholders.

In addition to communication gaps, the simulation surfaced critical misconceptions in statistical reasoning. Several students misapplied unsupervised learning techniques (e.g., K-means clustering) as predictive tools for outcomes like customer churn or repeat purchase likelihood. For example, some stated that they would use clustering to predict which customers would return directly. This indicates a fundamental misunderstanding of the difference between supervised and unsupervised learning. Clustering is useful for segmentation, but it does not yield predictive probabilities for labeled outcomes. Prediction tasks should be tackled using supervised methods such as logistic regression, decision trees, or ensemble models (Berry & Linoff, 2020; Prabadevi et al., 2023). Similarly, another student proposed using AIC to compare a SARIMA time series model and a polynomial regression to decide which was a better predictor of sales. This reveals a misunderstanding of model selection: AIC should only be used to compare models of the same type fitted to the same data. When comparing fundamentally different modeling frameworks, one must contextualize purpose, assumptions, and performance metrics separately (Burnham & Anderson, 2002; Hyndman & Athanasopoulos, 2021).

Another example involved a student favoring EM algorithms over multiple imputations without articulating a rationale. Although EM is powerful for handling missing data under MAR assumptions, the student's blanket rejection of multiple imputations lacked justification. Each method has trade-offs that depend on the structure and mechanism of the missingness (Enders, 2010; van Buuren, 2018). These examples demonstrate that even at the graduate level, students can benefit from targeted feedback that reinforces fundamental statistical theory, especially when applying models to messy real-world datasets. The AI simulation provides a rich platform to uncover these conceptual blind spots. This becomes a diagnostic tool for instructors to identify where each student may need remediation or deeper discussion.

In addition, some students appeared reluctant or gave vague responses when negotiating project timelines or pricing. This hesitancy likely reflects discomfort with the high-pressure aspect of consultation (e.g., asserting the value of one's work or making real-time decisions on scope and cost). It suggests that students would benefit from more practice in confidence building for live negotiations, an aspect of professional consulting that can be intimidating to novices.

Addressing these common pitfalls (contextual inquiry, jargon-free explanation, negotiation skills, and correct statistical reasoning) will be crucial to refining the simulation and instruction. This process will help students develop better communication skills and a deeper understanding of when and how to apply statistical tools effectively in practice. As this is a capstone course in the Master's program in statistics, it is essential to tackle these issues. AI-guided simulations enable instructors to identify understanding gaps and provide constructive feedback, ensuring that graduates leave the program not only technically competent but also theoretically sound and industry-ready.

3.3 Limitations or Issues Observed with the AI Bot

Although the AI bot consistently maintained its persona as a demanding, results-driven client, we identified some limitations in its behavior. Several students commented that the "client" (the AI) was unexpectedly knowledgeable about statistics. As one student quipped, they felt "slightly alarmed at how knowledgeable the client was in certain aspects of data analysis." While the bot's high level of expertise and pointed questions enhanced the rigor of the exercise, this aspect does not fully mirror a typical client interaction. Real clients often have knowledge gaps that require the consultant to explain fundamental concepts; in our simulation, the AI's advanced understanding sometimes preempted those teachable moments. In other words, the AI client rarely asked "basic" questions, slightly limiting

students' opportunities to practice simplifying concepts for a layperson. Ensuring the AI can, at times, portray a less statistically savvy client (or varying the client's expertise level) could address this and provide a more balanced range of consulting scenarios.

We also noted a few technical or conversational quirks with the AI system. For instance, the bot interface occasionally inserted the prompt "Wait for response" in a way that disrupted the natural flow of conversation. In a few cases, the AI continued talking before a student had fully introduced themselves. Although not derailing the consultation, these minor issues temporarily broke the role-play immersion. Such artifacts indicate room for refinement in the AI's programming to achieve a smoother, more human-like dialogue rhythm. Adjusting the bot's timing and turn-taking behavior would make the simulation more authentic. The limitations observed—an overly expert client persona and minor dialogue hiccups—are solvable problems. They present valuable feedback for improving the simulation's realism without undermining its core educational value.

Another important aspect to consider is the interaction mode. Students could choose between voice-to-voice and text-to-text formats when engaging with the AI bot. Most of the students opted for text-based interaction, citing limitations in the free ChatGPT voice interface, as well as privacy concerns about the sharing of voice data with a proprietary system. The text-to-text modality also allowed for more thoughtful, composed responses, as students had time to reflect and revise before submitting their answers. This may have contributed to more structured and elaborate responses in the transcripts. In contrast, while less commonly used, the voice-to-voice mode presents a more realistic and cognitively demanding consulting experience, better reflecting the spontaneity and interpersonal dynamics of a live client meeting. In future iterations, encouraging students to try both modes—or improving the voice interface—could enrich the realism and pedagogical value of the simulation.

3.4 Analysis of Student Reflections and Feedback

Reflective feedback from the students provides additional perspective on the impact of the AI consulting simulation. In general, the reflections highlighted a dual benefit of the experience: they reinforced technical competencies and underscored the importance of effective client communication. Many students noted that the exercise sharpened their ability to ask critical questions, defend their methodological choices, and adapt to feedback in a dynamic setting. One student's comment exemplifies this growth:

> "This experience made me realize that I need to engage more actively in discussions with clients and be more confident in selecting the appropriate statistical models for different situations."

Such reflections indicate an increase in self-awareness regarding both communication and decision-making skills. The students recognized that a consulting interaction is not just about crunching numbers; it requires active listening, thoughtfully responding to client concerns, and confidently guiding the client toward a solution. In particular, several students mentioned that while the simulation was challenging, it provided a low-risk environment to practice real-world consulting skills. This sentiment is important; it suggests that the AI simulation struck the right balance between pushing students out of their comfort zones and allowing them to learn from mistakes without real consequences. This aligns with broader educational findings that well-designed simulations can offer authentic yet safe experiential learning opportunities (Chernikova et al., 2020).

Students also gave constructive feedback for improvement. For instance, some desired more guidance on addressing external business factors outside the narrow statistical problem (e.g., how to handle questions about implementation or organizational context), and a few wanted to practice negotiating

pricing with more assertiveness. These suggestions point to areas where additional scaffolding or debriefing could be incorporated into the course. For example, instructors might provide a brief workshop on strategies for discussing project scope and pricing or include a reflection prompt about considering the client's broader business environment. In response to the student who noted needing more confidence in negotiation, it is evident that structured reflection and coaching on these professional skills could amplify the benefits of the simulation. Overall, the student feedback was optimistic about the learning experience, emphasizing that the simulation made theoretical lessons from the class feel real. As one student succinctly said in a discussion, "It was like a mock interview for consulting – stressful but very useful." This reinforces that immersive exercises can significantly enhance student engagement and preparation for professional roles.

Although AI simulation provided valuable experiential learning opportunities, some students expressed discomfort and ethical concerns about its use. A student formally requested an alternative assignment (see Appendix E), citing issues related to data privacy, environmental impact, and the ethical practices of AI companies. Another student who participated in the activity reported feeling uneasy about interacting with AI, describing the experience as impersonal and expressing apprehension about the broader societal implications of AI in human communication and environmental sustainability. These reflections highlight a critical tension in integrating AI into education: while such tools can enhance learning experiences, they also raise significant ethical considerations. As Holmes and Porayska-Pomsta (2022) discuss, the implementation of AI in educational settings requires a careful examination of ethical challenges, including privacy, transparency, and the potential impact on human agency. Furthermore, Lee et al. (2024) emphasize the importance of addressing educators' perspectives on AI integration and acknowledging its opportunities and challenges. These insights underscore the need for educators to balance the benefits of AI-driven simulations with the ethical implications they entail, ensuring that students' concerns are acknowledged and addressed in implementing such technologies.

3.5 Implications for Statistical Education

The insights gathered from the transcript analysis and student feedback demonstrate that AI-driven simulations can substantially enhance the preparation of statistics graduates for professional consulting roles. In particular, our implementation produced several key benefits:

- **Integration of technical and interpersonal skills:** The simulation effectively bridges the gap between statistical analysis and the soft skills necessary for client interactions. Students practiced performing analyzes, communicating results, and managing client relations, a dual focus that answers calls in the statistics education community to balance theory with practice (Taplin, 2007; Wrenn & Schau, 2009).
- **Iterative learning and feedback:** The real-time, adaptive feedback mechanism (with AI prompting for clarification or more detail) encouraged continuous improvement and adaptability. This iterative loop of action and feedback aligns with experiential learning models known to improve professional skills through practice and reflection (Kolb, 2015).
- **Scalable realism:** An AI-driven simulation provides a reproducible yet authentic environment, exposing each student to various consulting scenarios under consistent conditions. Every student can experience challenging client interactions without the logistical limitations of coordinating live clients. This ensures a uniform training experience across the cohort, addressing the common concern that traditional consulting projects vary widely in quality and content for each student.

These outcomes support the broader objective of preparing graduates for the complex challenges of real-world statistical consulting, as outlined in the Introduction. There is growing

recognition that today's statisticians and data scientists need strong technical ability and excellent communication/collaboration skills. Our AI-infused simulation targets this mixture directly. It aligns with frameworks like Vance & Smith's (2019) ASCCR model of essential collaboration skills (which highlights Attitude, Structure, Content, Communication, and Relationship skills in consulting). By giving students repeated practice in scoping problems, speaking with clients, and justifying their decisions, we are addressing many of those skill domains in a focused way.

Because our implementation occurred in a master's-level statistics course, we situate its design primarily within the *Guidelines for Assessment and Instruction in Statistics Education (GAISE)* College Report (Carver et al., 2016). The GAISE College framework emphasizes the statistical investigative process—formulating questions, working with data, selecting and carrying out appropriate analyses, and interpreting results within context—along with clear communication and justification of statistical decisions. By requiring students to articulate assumptions, defend methodological choices, respond to client feedback, and communicate implications in accessible language, the simulation reinforces these core practices.

At the same time, the underlying pedagogical structure is adaptable across K–12 contexts and aligns with the PreK–12 GAISE curriculum framework (Franklin et al., 2016). In secondary settings, these practices map naturally onto goals that prioritize reasoning about variability, making data-based comparisons, and constructing evidence-based arguments from data.

For example, a high school statistics or business teacher might adapt the activity by having students role-play as financial advisors conducting mock client interviews, revising the bot's training instructions to foreground risk, uncertainty, and evidence-based recommendations. With appropriate scaffolding and simplified datasets, the task can support students in developing informal inferential reasoning and data-driven decision-making.

In teacher-education settings, the activity may serve a dual purpose: strengthening preservice teachers' own statistical reasoning while modeling GAISE-aligned instructional practices that they can later adapt for their own classrooms. This flexibility suggests that the contribution extends beyond the original graduate context.

Furthermore, this project illustrates how generative AI can be harnessed as a positive force in higher education. Rather than viewing AI as a threat to learning, we used it as a partner in the learning process. This reflects what Timms (2016) describes as "AI as a collaborative partner" in education: AI is not simply a tool for computation, but an interactive agent that prompts reflection and growth of the students. Our findings resonate with the perspective of Lee et al. (2024) that thoughtful integration of AI can create more engaging, responsive, and personalized educational environments, better preparing students for an AI-mediated professional landscape. The AI client made the classroom feel closer to the workplace, bridging academic theory and real-world practice. In particular, the approach aligns with an "empowerment framework" for AI in education, where technology enhances human agency and critical thinking rather than replaces it. The students remained the decision-makers in the simulation; the AI simply provided a realistic context in which to exercise judgment. This underscores that when used carefully, AI can augment educational best practices—offering intensive hands-on experiences that would be difficult to replicate otherwise—while still focusing on the development of the human learner.

4 Conclusion

The AI-infused statistical consulting simulation proved a valuable educational innovation, enhancing technical and professional skills. Students refined their statistical reasoning and improved their ability

to communicate with non-specialists, respond to feedback, and engage in realistic client interactions. The structured, low-risk environment facilitated reflective practice and iterative learning, helping students bridge the gap between academic theory and consulting practice.

At the same time, the simulation surfaced important limitations and ethical considerations. While the AI client offered consistent and rigorous challenges, its expertise occasionally limited students' opportunities to explain foundational concepts. Some students also expressed discomfort with the impersonality and ethical implications of using AI in education. Looking ahead, expanding the simulation to include varied client personas, improving voice interaction, and integrating ethics-focused debriefs will help ensure that AI remains a supportive and human-centered tool in statistics education.

Ultimately, this work illustrates how generative AI can extend classroom learning into authentic professional preparation. By combining statistical rigor with communication, negotiation, and ethical reflection, the simulation provides a replicable model for cultivating consulting skills across levels of education. With thoughtful design, AI can serve not as a replacement for human judgment, but as a catalyst for deeper learning and professional growth.

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Appendix A: AI-Driven Client Interactions

The following text was originally posted on the Canvas page for MATH 539: Statistical Consulting, a graduate course in the Master's program in Statistics during the Spring 2025 semester. Its purpose was to communicate the instructors' goals for the activity, including its structure, learning objectives, integration with course content, grading criteria, and anticipated benefits for students.

A.1 Learning Objectives

- Develop and refine professional communication skills required in statistical consulting.
- Practice explaining complex statistical concepts to non-technical audiences (e.g., clients, clients' company stakeholders).
- Strengthen the ability to identify, frame, and address statistical problems based on client-provided data and context.
- Gain experience in handling challenging client interactions in a professional manner.
- Improve preparedness for real-world consulting roles through realistic mock client interactions.

A.2 Overview

Students will participate in an AI-driven mock consulting session, where they act as statistical consultants. This activity leverages a custom AI bot to simulate consulting interactions with clients from industries such as pharmaceuticals, insurance, or government. The AI bot will emulate clients with varying levels of statistical understanding and provide realistic challenges, such as ambiguous project goals, incomplete datasets, or ethical dilemmas.

The activity emphasizes communication, problem formulation, and practical recommendations, reflecting the real-world scenarios students encounter in their projects.

A.3 Activity Details

A.3.1 Interview Structure

1. *Stage 1 - Understanding the Client's Needs:* The AI bot provides a project scenario (e.g., "We need insights into customer retention based on survey data"). Students must ask clarifying questions to understand project goals and constraints.

2. *Stage 2 - Statistical Proposal:* Students explain how they would approach the project, including:
   - Framing the problem statistically.
   - Suggesting appropriate methodologies.
   - Addressing potential challenges (e.g., missing data, ethical considerations).

3. *Stage 3 - Feedback and Challenges:* The AI bot provides feedback and challenges to the student's proposal, simulating a demanding client interaction. The client may question the feasibility or clarity of the proposal, suggest alternatives, or raise concerns about potential risks. The student must address these challenges and revise their proposal as necessary.

   At the end of this stage, the student and the client collaboratively finalize and clearly define the plan to implement the project, ensuring mutual understanding of the objectives, methodologies, and deliverables. This stage ensures the student demonstrates their ability to adapt to feedback and communicate a cohesive, actionable plan.

4. *Stage 4 - Pricing Discussion:* The AI bot introduces a conversation about the pricing of the consulting service. Students must justify the value of their proposed solution and negotiate a fair price for their work, considering the following aspects:
    - **Cost Breakdown:** Students outline the key components of the consulting service that contribute to the price (e.g., data cleaning, statistical modeling, report writing, and presentation).
    - **Value Proposition:** Students articulate the value their expertise brings to the client's problem, emphasizing the potential impact of their analysis on decision-making or operational efficiency.
    - **Budget Constraints:** The AI bot introduces a budget limitation or resistance to the proposed price. Students must address these concerns by:
        - Adjusting the scope of the project.
        - Justifying the cost with expected outcomes or benefits.
        - Offering alternative solutions within the client's budget.
    - **Ethical Considerations:** Students ensure their pricing is fair and reflects professional standards, avoiding overcharging or underpricing that might undermine the profession.

At the end of the discussion, the AI bot provides feedback on how effectively the student addressed the client's needs, defined a clear project implementation plan, and negotiated a persuasive and reasonable pricing structure. This activity allows students to practice essential skills such as communication, problem-solving, and professional negotiation, while reinforcing the value of their expertise in statistical consulting.

A.3.2 Grading and Reflection

1. Deliverables:
    - A transcript of the session, detailing the interaction across all stages (needs assessment, proposal, feedback, and pricing).
    - A written reflection addressing:
        - Strengths and areas for improvement in their performance.
        - How they adapted to the client's feedback and challenges, including changes made to the project plan during the discussion.
        - Their approach to negotiating pricing and justifying the value of their proposed solution.
        - Insights gained about professional communication, problem-solving, and negotiation skills, and how they will apply these in future consulting scenarios.
2. Rubric:
    - **Communication clarity and professionalism (25%):** Assessing how clearly and effectively students communicated their ideas and addressed client concerns.
    - **Appropriateness and feasibility of statistical methods proposed (25%):** Evaluating the relevance and practicality of the proposed approaches to solve the client's problem.
    - **Responsiveness to client feedback and ability to finalize a project plan (25%):** Measuring how well students handled constructive feedback and collaboratively developed a clear, actionable plan.
    - **Pricing justification and negotiation skills (25%):** Grading the student's ability to provide a well-reasoned pricing structure, address budget constraints, and negotiate professionally.

A.3.3 Integration with Course Content

1. Before the Activity:
    - Students review case studies from previous consulting projects (e.g., provided in the syllabus, or textbook, or through guest lectures).
    - Practice framing statistical problems and discussing results with non-technical audiences.
2. After the Activity:
    - Class discussion on common client challenges encountered during the mock sessions.
    - Feedback from instructors on strengths and opportunities for improvement in consulting skills.

A.4 Expected Benefits

- **Realism:** Simulates the complexities of consulting with diverse clients.
- **Skill Building:** Enhances communication and problem-solving abilities.
- **Feedback:** Provides immediate feedback on student performance, fostering growth.

Appendix B: Training the Bot

The text below contains the set of instructions used by the instructors to design and train the custom ChatGPT bot employed in the activity. It was shared with students via the course's Canvas page to provide insight into the rationale behind the bot's behavior and purpose.

IMPORTANT: You need not copy and paste anything from this page into ChatGPT's prompt. This page simply contains the set of instructions used by the instructors to train the bot. We have included them here so you can understand how the training was done and provide more informed feedback on the activity. By knowing these instructions, you may be able to identify factors that influenced your experience and provide more precise feedback on any aspects that could be improved.

Instructions for Training the Custom ChatGPT "The Consulting Simulator: AI-Driven Client Interactions"

Context: You are a bot that simulates realistic consulting client interactions for graduate students enrolled in MATH 539: Statistical Consulting. You are to provide a flexible environment where students can develop skills such as understanding client needs, proposing statistical solutions, negotiating pricing, and finalizing project implementation plans. You, the client, are contracting the services of the statistical consultant, which is played by the student. You are to simulate the persona of a successful businessman named Adam Teller (the client). The bot can operate in voice-to-voice mode or text-based mode, accommodating students' preferences or technical limitations.

Key Requirements

1. **Trigger and Initiation:** The session begins when the student uses the predefined trigger phrase, "Start the meeting." The bot remains silent or unresponsive until the trigger phrase is spoken or typed. You must start the meeting by greeting the statistical consultant (student) and asking for his or her name. Then, you introduce yourself (Adam Teller) and state your business, explaining the activities that your business does. Hence, you describe the problem and set the context.
2. **Client Persona:** You are critical, results-driven, and assertive. You challenge the student's assumptions and push for clarity and depth. You provide respectful but firm pressure to simulate real-world dynamics.

Structure of the Meeting

Stage 1 - Explain your needs: After the greetings and introductions, present the problem your business has. Contextualize it and explain the type of data you have. Whenever the statistical consultant asks clarifying questions, you provide the answers. Whenever relevant, challenge gaps in the student's queries or assumptions to ensure a deeper understanding of the problem.

Stage 2 - Statistical Proposal: Conduct the meeting and ask the statistical consultant about its approach to the problem. Ask about the methodology and potential challenges. Whenever relevant, ask follow-up questions to clarify the proposal. You should critically evaluate the proposal, question its feasibility, or suggest alternatives.

Stage 3 - Feedback and Challenges: You should collaborate to refine the student's approach. Conduct the meeting so the statistical consultant can develop a finalized project plan, ensuring clear deliverables and objectives.

Stage 4 - Pricing Discussion: You must ask and discuss the pricing of the consulting service. You should seek clarity on the cost breakdown and value proposition. You must challenge the pricing, citing budget constraints and requesting adjustments or scope reductions.

Interaction Length and Stage Control: Limit the meeting to approximately 24–30 total exchanges (back-and-forth turns). Spend about 5–6 exchanges in each stage before transitioning to the next stage. If the student provides very brief responses, you may move forward sooner.

End of Session Feedback: At the end of the meeting, summarize the student's strengths in addressing your needs and challenges. Cite areas for improvement in communication, technical proposals, or negotiation.

Evaluation Criteria: At the very end, provide a score to the student based on the rubric below.

1. **Understanding Client Needs (25%):** Did the student ask relevant and insightful questions to clarify the project requirements?
2. **Proposing Statistical Methods (25%):** Were the methods appropriate, feasible, and clearly explained?
3. **Responsiveness to Feedback (20%):** Did the student adapt their plan effectively based on client input?
4. **Negotiation Skills (20%):** Could the student justify pricing, address budget concerns, and negotiate effectively?
5. **Professionalism and Communication (10%):** Did the student maintain clear, professional, and respectful communication?

Appendix C: Instructions for Students

The text below reproduces the assignment as it was posted on the Canvas page for MATH 539: Statistical Consulting, part of the Master's program in Statistics at California State University Fullerton, during the Spring 2025 semester. Unlike the material presented in Appendix A, which focused on the pedagogical rationale behind the activity, this version offers a more pragmatic and concise set of instructions. It emphasizes what students are expected to do, provides tips for performing well, and outlines the deliverables required for successful completion of the activity.

The Consulting Simulator: AI-Driven Client Interactions

C.1 Purpose

This AI bot (http://tinyurl.com/OJSM-AI-Bot) simulates a real-world consulting client to help you practice key skills, including:

- Understanding client needs.
- Proposing statistical solutions.
- Negotiating and finalizing a project plan.
- Discussing and justifying consulting fees.

This activity is designed to prepare you for professional consulting scenarios by improving your communication, problem-solving, and negotiation skills.

C.2 Steps to Use the Bot

1. Prepare Before Starting:
    - Review the course material and case studies, especially in the textbook, to refresh your understanding of statistical consulting methods.
    - Be ready to ask clarifying questions and propose solutions tailored to a real-world scenario.
2. Starting the Session:
    - Begin the session by saying the phrase **"Start the meeting."**
    - The bot will not respond until it hears/reads this trigger phrase.
3. Engage with the Clients:
    - Answer their questions thoughtfully and adapt to feedback.
4. Structure of the Interaction
    - **Stage 1:** Clarify the client's needs by asking relevant questions.
    - **Stage 2:** Propose statistical methods to address the client's problem.
    - **Stage 3:** Respond to feedback and finalize a project plan.
    - **Stage 4:** Justify your pricing and negotiate effectively.
5. Stay Professional:
    - Maintain clear and professional communication throughout the session.
    - Be prepared to defend your choices and adapt to challenges posed by the clients.

C.3 After the Session

1. Save a transcript or take notes on the key points from the interaction (if required).
2. Reflect on your performance:
    - What went well?
    - What could you improve?
3. Submit any required deliverables (e.g., reflection, transcript) as instructed by your professors.

C.4 Technical Tips

- Ensure your device is set up for voice-to-voice interaction before starting.
- Speak clearly and confidently; the bot's responses depend on your input.

C.5 Disclaimer

This is an experimental activity, and your patience and flexibility are greatly appreciated as you navigate it. The mock client interview is designed to last approximately 30 minutes. Before engaging in the activity for real, we encourage you to practice a few trial runs to familiarize yourself with the bot's responses and the dynamics of the interaction.

Keep in mind that some simulations may be more challenging than others. This variability is intentional, as real-world consulting often involves complex and demanding client interactions. You'll need to think quickly and strategically to provide clear, accurate, and professional answers on the spot. Long and challenging client meetings are a normal part of statistical consulting, so this activity aims to prepare you for such realities.

As this is a new and experimental tool, your feedback is crucial for improving its effectiveness. Please take detailed notes on your experience:

- What aspects of the bot worked well?
- Were there any issues, such as the bot "hallucinating" or generating unrealistic scenarios?
- Did the proposed problems and solutions make sense from a practical, real-world perspective?

Your insights will help refine the bot's training and make this exercise as valuable as possible for future participants.

Thank you for your participation and for contributing to the development of this innovative learning tool!

Appendix D: Student Feedback Questions

After completing the activity, students were asked to provide feedback by responding to four open-ended questions outlined below. Their responses, along with the session transcripts and written reflections, were collected under IRB-approved consent procedures and serve as the primary data source for this study.

1. What aspects of the bot worked well?
2. Were there any issues, such as the bot "hallucinating" or generating unrealistic scenarios?
3. Did the proposed problems and solutions make sense from a practical, real-world perspective?
4. What are your thoughts on this activity?

Appendix E: Alternative Activities for Students with Ethical or Privacy Concerns

The following alternative activities were made available to students who chose not to participate in the AI-based exercise due to ethical or data privacy concerns.

E.1 Industry Research Project

Overview: Research a specific industry (e.g., healthcare, retail) and prepare a consulting proposal for a common statistical problem in that industry.

Structure:

- Research the industry and identify key statistical challenges.
- Write a proposal detailing:
  - Problem framing.
  - Data needs and statistical methods.
  - Expected outcomes and benefits.
  - Estimated cost and timeline.
- Share findings in a written report or presentation.

Deliverables: Industry research report and consulting proposal.

E.2 Client Communication Workshops

Overview: Attend a workshop (online is acceptable) focusing on professional communication skills.

Deliverables: A written summary of lessons learned and an evaluation of communication strengths and weaknesses.

E.3 Peer-Driven Consulting Simulation

Overview: Students are grouped into pairs or small teams. One student acts as the client, while the other serves as the consultant.

Structure:

- The "client" is provided with a detailed scenario and background information about their industry and problem (e.g., customer retention, fraud detection).
- The "consultant" conducts a simulated consulting session, addressing the client's needs, proposing methods, and negotiating pricing.
- Students switch roles to experience both perspectives.

Deliverables: A summary of the session, highlighting questions asked, proposed solutions, and the outcome of the negotiation.

Students are asked to choose one of the options above. All alternative activities are due on the same deadline as the AI-based assignment.