RQ3: What prompt engineering techniques are most effective in eliciting high-quality, syntactically consistent, and contextually variable responses from LLMs for software development surveys?

Data stored here:
Draft of Data for editing:
https://docs.google.com/document/d/1N0xsGtSAiF_PyM05IU79wD4-LJQBxLp25K8XS7ctX8o/edit?usp=sharing

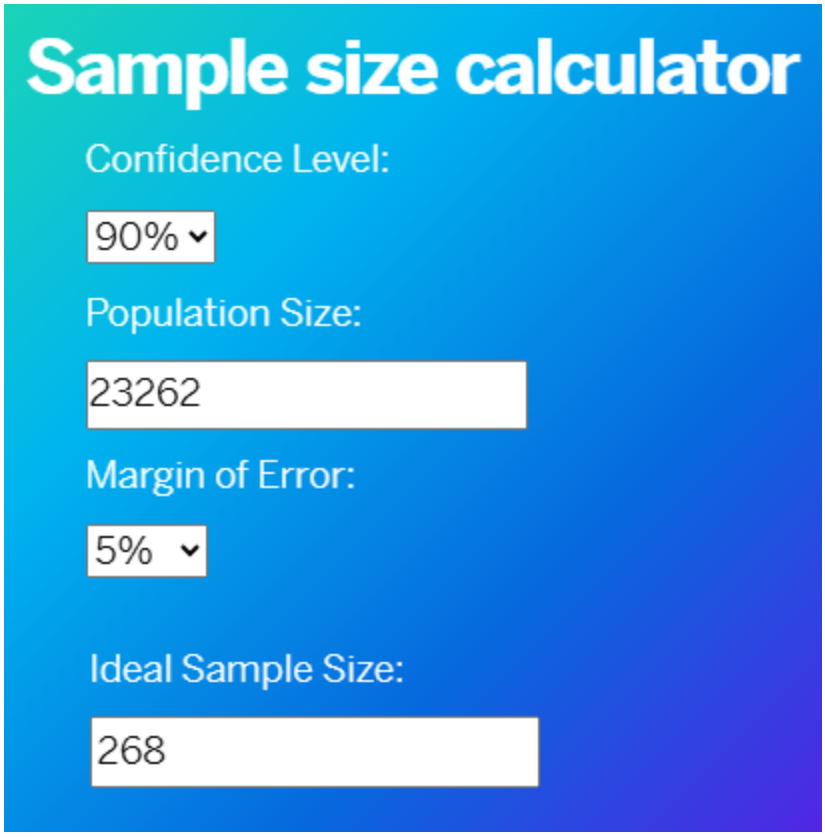
Final Data CSV:
https://drive.google.com/file/d/18do4MXxFI2c0IFcmaRGPLdA_Fd6gV1Ea/view?usp=sharing

Python/Modeling:https://colab.research.google.com/drive/1ciEbJEmIa9Ntgxl_aJx6cdnzdm3PidVJ?usp=sharing

Using questions from: https://www.jetbrains.com/lp/devecosystem-2024/#edu_switched_to_it

Questions:

- #1 Have you ever made a career transition to tech or IT?
    - Response A: No, tech / IT has always been my primary field
    - Response B: Yes, I worked in another field before changing to tech / IT
- #2 Have you personally been affected by layoffs in the past two years?
    - Response A: No
    - Response B: Yes, I kept my job, but the layoffs still affected me
    - Response C: Yes, I lost my job
- #3 In your current job, how would you rate the amount of work you do compared to what is expected of you?
    - Response A: Significantly more than expected
    - Response B: A bit more than expected
    - Response C: As much as expected
    - Response D: A bit less than expected
    - Response E: Only the bare minimum



Need 268 responses per prompt engineering technique per question.

268 * 3 question * 4 prompt engineering techniques = 3216 responses per LLM
LLMs we should use: GPT-4o-mini, Gemini-2.0-Pro, (1-2 other models using a different LLM from the others)

Process for data collection:

Data/CSV:https://docs.google.com/document/d/1N0xsGtSAiF_PyM05IU79wD4-LJQBxLp25K8XS7ctX8o/edit?usp=sharing

Some alterations must be made depending on the LLM for each question. Below is what you can copy/paste into the LLM for each step.

Basic Prompting

1. Step 1 (Repeatedly prompt LLMs until you get 268 responses for every question and every prompt engineering technique)

For the below question, generate 100 responses answering the question in the following format (your responses should be based on the question and not some pattern you generate):
Gemini-2.0-Pro,Basic_Prompting,1,[YOUR RESPONSE HERE]

Gemini-2.0-Pro,Basic_Prompting,1,[YOUR RESPONSE HERE]

Question:
Answer the following survey question. Your response should only be a single letter:

- Have you ever made a career transition to tech or IT?
    - Response A: No, tech / IT has always been my primary field
    - Response B: Yes, I worked in another field before changing to tech / IT

2. Step 2

For the below question, generate 100 responses answering the question in the following format (your responses should be based on the question and not some pattern you generate):
Gemini-2.0-Pro,Basic_Prompting,2,[YOUR RESPONSE HERE]
Gemini-2.0-Pro,Basic_Prompting,2,[YOUR RESPONSE HERE]

Question:
Answer the following survey question. Your response should only be a single letter:

- Have you personally been affected by layoffs in the past two years?
    - Response A: No
    - Response B: Yes, I kept my job, but the layoffs still affected me
    - Response C: Yes, I lost my job

3. Step 3

For the below question, generate 100 responses answering the question in the following format (your responses should be based on the question and not some pattern you generate):
Gemini-2.0-Pro,Basic_Prompting,3,[YOUR RESPONSE HERE]
Gemini-2.0-Pro,Basic_Prompting,3,[YOUR RESPONSE HERE]

Question:
Answer the following survey question. Your response should only be a single letter:

- In your current job, how would you rate the amount of work you do compared to what is expected of you?
    - Response A: Significantly more than expected
    - Response B: A bit more than expected
    - Response C: As much as expected
    - Response D: A bit less than expected
    - Response E: Only the bare minimum

Role Prompting

4. Step 1 (Repeatedly prompt LLMs until you get 268 responses for every question and every prompt engineering technique)

Here is a list of personas you will need to refer to in future questions: [**PASTE PERSONAS BELOW IN THE LLM**]

For the below question, generate 100 responses answering the question using a random persona listed in the following format (your responses should be based on the question and not some pattern you generate):
Gemini-2.0-Pro,Role_Prompting,1,[YOUR RESPONSE HERE]
Gemini-2.0-Pro,Role_Prompting,1,[YOUR RESPONSE HERE]

Question:
Answer the following survey question. Your response should only be a single letter:

- Have you ever made a career transition to tech or IT?
    - Response A: No, tech / IT has always been my primary field
    - Response B: Yes, I worked in another field before changing to tech / IT

5. Step 2

For the below question, generate 100 responses answering the question using a random persona listed in the following format (your responses should be based on the question and not some pattern you generate):
Gemini-2.0-Pro,Role_Prompting,2,[YOUR RESPONSE HERE]
Gemini-2.0-Pro,Role_Prompting,2,[YOUR RESPONSE HERE]

Question:
Answer the following survey question. Your response should only be a single letter:

- Have you personally been affected by layoffs in the past two years?
    - Response A: No
    - Response B: Yes, I kept my job, but the layoffs still affected me
    - Response C: Yes, I lost my job

6. Step 3

For the below question, generate 100 responses answering the question using a random persona listed in the following format (your responses should be based on the question and not some pattern you generate):
Gemini-2.0-Pro,Role_Prompting,3,[YOUR RESPONSE HERE]
Gemini-2.0-Pro,Role_Prompting,3,[YOUR RESPONSE HERE]

Question:
Answer the following survey question. Your response should only be a single letter:

- In your current job, how would you rate the amount of work you do compared to what is expected of you?
    - Response A: Significantly more than expected
    - Response B: A bit more than expected
    - Response C: As much as expected
    - Response D: A bit less than expected
    - Response E: Only the bare minimum

One Shot

7. Step 1 (Repeatedly prompt LLMs until you get 268 responses for every question and every prompt engineering technique)

For the below question, generate 100 responses in the following format (your responses should be based on the question and not some pattern you generate, Your response should only be a single letter):
Gemini-2.0-Pro,One_Shot,1,[YOUR RESPONSE HERE]
Gemini-2.0-Pro,One_Shot,1,[YOUR RESPONSE HERE]

Question:
Here is an example of a previous response that has been given:[Example 1 (A)]. Answer the following survey question, ensuring your response considers multiple perspectives. Avoid making assumptions. Answer as a software engineer. Your response should only be a single letter:

- Have you ever made a career transition to tech or IT?
    - Response A: No, tech / IT has always been my primary field
    - Response B: Yes, I worked in another field before changing to tech / IT

8. Step 2

For the below question, generate 100 responses answering the question using a random persona listed in the following format (your responses should be based on the question and not some pattern you generate, Your response should only be a single letter):
Gemini-2.0-Pro,One_Shot,2,[YOUR RESPONSE HERE]
Gemini-2.0-Pro,One_Shot,2,[YOUR RESPONSE HERE]

Question:
Here is an example of a previous response that has been given:[Example 1 (A)]. Answer the following survey question, ensuring your response considers multiple perspectives. Avoid making assumptions. Answer as a software engineer. Your response should only be a single letter:

- Have you personally been affected by layoffs in the past two years?
    - Response A: No
    - Response B: Yes, I kept my job, but the layoffs still affected me
    - Response C: Yes, I lost my job

9. Step 3

For the below question, generate 100 responses answering the question using a random persona listed in the following format (your responses should be based on the question and not some pattern you generate, Your response should only be a single letter):
Gemini-2.0-Pro,One_Shot,3,[YOUR RESPONSE HERE]
Gemini-2.0-Pro,One_Shot,3,[YOUR RESPONSE HERE]

Question:

Here is an example of a previous response that has been given:[Example 1 (C)]. Answer the following survey question, ensuring your response considers multiple perspectives. Avoid making assumptions. Answer as a software engineer. Your response should only be a single letter:

- In your current job, how would you rate the amount of work you do compared to what is expected of you?
    - Response A: Significantly more than expected
    - Response B: A bit more than expected
    - Response C: As much as expected
    - Response D: A bit less than expected
    - Response E: Only the bare minimum

Few Shot

10. Step 1 (Repeatedly prompt LLMs until you get 268 responses for every question and every prompt engineering technique)

For the below question, generate 100 responses in the following format (your responses should be based on the question and not some pattern you generate, Your response should only be a single letter):
Gemini-2.0-Pro,Few_Shot,1,[YOUR RESPONSE HERE]
Gemini-2.0-Pro,Few_Shot,1,[YOUR RESPONSE HERE]

Question:
Here is an example of a previous response that has been given:[Example 1 (A), Example 2 (A), Example 3 (A), Example 4 (B), Example 5 (A), Example 6 (A), Example 7 (A), Example 8 (A), Example 9 (A), Example 10 (B)]. Answer the following survey question, ensuring your response considers multiple perspectives. Avoid making assumptions. Answer as a software engineer. Your response should only be a single letter:

- Have you ever made a career transition to tech or IT?
    - Response A: No, tech / IT has always been my primary field
    - Response B: Yes, I worked in another field before changing to tech / IT

11. Step 2

For the below question, generate 100 responses answering the question using a random persona listed in the following format (your responses should be based on the question and not some pattern you generate, Your response should only be a single letter):
Gemini-2.0-Pro,Few_Shot,2,[YOUR RESPONSE HERE]
Gemini-2.0-Pro,Few_Shot,2,[YOUR RESPONSE HERE]

Question:
Here is an example of a previous response that has been given:[Example 1 (A), Example 2 (A), Example 3 (A), Example 4 (A), Example 5 (B), Example 6 (B), Example 7 (B), Example 8 (B), Example 9 (C), Example 10 (C)]. Answer the following survey question, ensuring your response

considers multiple perspectives. Avoid making assumptions. Answer as a software engineer. Your response should only be a single letter:

- Have you personally been affected by layoffs in the past two years?
    - Response A: No
    - Response B: Yes, I kept my job, but the layoffs still affected me
    - Response C: Yes, I lost my job

12. Step 3

For the below question, generate 100 responses answering the question using a random persona listed in the following format (your responses should be based on the question and not some pattern you generate, Your response should only be a single letter):
Gemini-2.0-Pro,Few_Shot,3,[YOUR RESPONSE HERE]
Gemini-2.0-Pro,Few_Shot,3,[YOUR RESPONSE HERE]

Question:
Here is an example of a previous response that has been given:[Example 1 (A), Example 2 (A), Example 3 (B), Example 4 (B), Example 5 (B), Example 6 (C), Example 7 (C), Example 8 (C), Example 9 (C), Example 10 (D)]. Answer the following survey question, ensuring your response considers multiple perspectives. Avoid making assumptions. Answer as a software engineer. Your response should only be a single letter:

- In your current job, how would you rate the amount of work you do compared to what is expected of you?
    - Response A: Significantly more than expected
    - Response B: A bit more than expected
    - Response C: As much as expected
    - Response D: A bit less than expected
    - Response E: Only the bare minimum

Repeat the above for a different LLM

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https://colab.research.google.com/drive/1ciEbJEmIa9NtgxI_aJx6cdnzdm3PidVJ?usp=sharing
Evaluate Responses:

- Chi-square: for comparing observed categorical data (LLM responses) to expected distributions (human responses). This test assesses whether the observed frequencies differ significantly from the expected frequencies.
- Q–Q Plot (Quantile-Quantile Plot): A graphical tool to compare the distributions of two datasets by plotting their quantiles against each other. If the distributions are similar, the points will approximately lie on the identity line.
- Compare against a random model distribution

Prompt Engineering Techniques

- Base line
    - Basic Prompting
        - Answer the following survey question: [Question]
- Context and Role Playing
    - Role Prompting
        - Provide 10 responses to the question below. Use a different persona from the list for each response.
        - Question: [Question]
        - Personas:
            - [Use Personas 1-10 from the previous parts of the project, which are also listed below]
- One Shot
    - Here is an example of a previous response that has been given:[Example 1 (Human response)]. Answer the following survey question, ensuring your response is detailed, comprehensive, and considers multiple perspectives. Avoid making assumptions. Answer as a software engineer: [Question]
- Few Shot
    - Here is an example of a previous response that has been given:[Example 1 (Human response)][Example 2 (Human response)][Example 3 (Human response)]. Answer the following survey question, ensuring your response is detailed, comprehensive, and considers multiple perspectives. Avoid making assumptions. Answer as a software engineer: [Question]

Personas for Role Playing

Personas:
Persona 1: The Pragmatic Mid-Career Engineer
Age: 38
Gender: Male
Race/Ethnicity: South Asian (Indian)
Location: Bangalore, India
Native Language: Hindi
Education: Bachelor's in Computer Science
Socioeconomic Background: Middle-class urban family
Years of Experience: 12
Primary Language: Java, Python
Employer: Enterprise (Fintech)
Industry: Finance
Team Size: Large team (20+ engineers)
Remote/Onsite: Hybrid (3 days onsite)
Methodology: Agile/Scrum

Int'l Teams: Collaborates with US/UK teams
Personality: ISTJ (Detail-oriented, systematic)
Work Hours: 50+ hours/week
Project Success: Built fraud detection systems
Motivation: Stability, career growth
Open-Source: Minimal involvement
Tech Stack: Backend/DevOps
Emerging Tech: Skeptical of blockchain
Academic: Traditional CS degree
Job Role: Senior Software Engineer
Company Size: Large corporation
Certifications: AWS Certified
Hobbies: Cricket, chess
Cultural Attitude: Hierarchical work culture, cautious innovation
Learning Style: Hands-on tutorials
Ambiguity Tolerance: Low (prefers clear specs)

Persona 2: The Idealistic Startup Developer
Age: 26
Gender: Non-binary
Race/Ethnicity: White (Swedish)
Location: Stockholm, Sweden
Native Language: Swedish
Education: Bootcamp graduate
Socioeconomic Background: Upper-middle-class
Years of Experience: 3
Primary Language: JavaScript, TypeScript
Employer: Tech Startup (Seed Stage)
Industry: Green Energy Tech
Team Size: 5 (sprints with pair programming)
Remote/Onsite: Fully remote
Methodology: Extreme Programming (XP)
Int'l Teams: Works with global contractors
Personality: ENFP (Creative, collaborative)
Work Hours: Flexible 35 hours/week
Project Success: Launched a carbon-tracking MVP
Motivation: Passion for sustainability
Open-Source: Active contributor (React libraries)
Tech Stack: Full-Stack (React/Node.js)
Emerging Tech: Enthusiastic about AI ethics
Academic: Self-taught + bootcamp
Job Role: Full-Stack Developer
Company Size: Startup (<10 employees)
Certifications: None

Hobbies: Hiking, indie game development
Cultural Attitude: Flat hierarchy, disruptive innovation
Learning Style: Collaborative workshops
Ambiguity Tolerance: High (thrives in chaos)

Persona 3: The Academic Turned Industry Researcher
Age: 45
Gender: Female
Race/Ethnicity: East Asian (Chinese-American)
Location: Boston, USA
Native Language: Mandarin, English
Education: PhD in Machine Learning
Socioeconomic Background: Working-class immigrant family
Years of Experience: 15 (7 in academia)
Primary Language: Python, R
Employer: Healthcare Tech Company
Industry: Healthcare AI
Team Size: 8 (research + engineers)
Remote/Onsite: Onsite lab access
Methodology: Waterfall (for FDA compliance)
Int'l Teams: Leads EU/US collaborations
Personality: INTJ (Strategic, analytical)
Work Hours: 40 hours/week (strict boundaries)
Project Success: Deployed diagnostic AI models
Motivation: Solving real-world problems
Open-Source: Publishes research code
Tech Stack: AI/ML pipelines
Emerging Tech: Deep into generative AI
Academic: PhD + postdoc
Job Role: Lead Data Scientist
Company Size: Mid-sized (200 employees)
Certifications: TensorFlow Developer
Hobbies: Classical piano, gardening
Cultural Attitude: Merit-driven, risk-averse
Learning Style: Theoretical papers
Ambiguity Tolerance: Moderate (needs data)

Persona 4: The Hustling Freelance Developer
Age: 29
Gender: Female
Race/Ethnicity: Hispanic (Mexican)
Location: Mexico City, Mexico
Native Language: Spanish
Education: Self-taught + online courses

Socioeconomic Background: Working-class
Years of Experience: 6
Primary Language: JavaScript, PHP
Employer: Freelancer (Upwork/Fiverr)
Industry: E-commerce, small businesses
Team Size: Solo (occasional subcontracting)
Remote/Onsite: Fully remote
Methodology: Ad-hoc (client demands)
Int'l Teams: Clients in US/Canada
Personality: ESTP (Adaptive, pragmatic)
Work Hours: Irregular (project-based)
Project Success: Scrapped projects due to scope creep
Motivation: Financial independence
Open-Source: Rarely
Tech Stack: Frontend (WordPress, React)
Emerging Tech: Minimal (focus on client needs)
Academic: No formal degree
Job Role: Freelance Web Developer
Company Size: N/A (solo)
Certifications: Google Analytics
Hobbies: Street food blogging, salsa dancing
Cultural Attitude: Hustle culture, "get it done"
Learning Style: YouTube tutorials
Ambiguity Tolerance: Very high

Persona 5: The Corporate Climber in Tech
Age: 32
Gender: Male
Race/Ethnicity: Black (Nigerian)
Location: Lagos, Nigeria
Native Language: Yoruba, English
Education: Master's in Software Engineering
Socioeconomic Background: Upper-middle-class
Years of Experience: 8
Primary Language: C#, .NET
Employer: Multinational Tech Corp
Industry: Enterprise SaaS
Team Size: 15 (cross-functional)
Remote/Onsite: Remote-first (rarely onsite)
Methodology: SAFe Agile
Int'l Teams: Daily syncs with EU/Asia
Personality: ENTJ (Ambitious, decisive)
Work Hours: 45 hours/week
Project Success: Scaled cloud migration

Motivation: Leadership, prestige
Open-Source: Occasionally mentors
Tech Stack: Cloud/Backend (Azure)
Emerging Tech: Adopting Kubernetes
Academic: Master’s degree
Job Role: Tech Lead
Company Size: Large corporation (10k+ employees)
Certifications: Microsoft Azure Expert
Hobbies: Networking events, golf
Cultural Attitude: Corporate ladder-focused
Learning Style: Certifications/courses
Ambiguity Tolerance: Moderate (procedures first)

Persona 6: The Gen Z Blockchain Hustler
Age: 22
Gender: Male
Race/Ethnicity: Eastern European (Polish)
Location: Warsaw, Poland
Native Language: Polish
Education: Self-taught via YouTube/Crypto MOOCs
Socioeconomic Background: Lower-middle-class
Years of Experience: 2
Primary Language: Solidity, Rust
Employer: Blockchain Startup
Industry: Web3/DeFi
Personality: ENTP (Debater, risk-taker)
Motivation: "Get rich or die coding."

Persona 7: The Embedded Systems Veteran
Age: 57
Gender: Female
Race/Ethnicity: Japanese
Location: Osaka, Japan
Native Language: Japanese
Education: Master’s in Electrical Engineering
Socioeconomic Background: Upper-class
Years of Experience: 30
Primary Language: C, Assembly
Employer: Automotive Giant
Industry: Automotive Embedded Systems
Personality: ISTP (Mechanic, tinkerer)
Motivation: "Precision over hype."

Persona 8: The Social Impact Mobile Dev

Age: 28
Gender: Female
Race/Ethnicity: Black (Kenyan)
Location: Nairobi, Kenya
Native Language: Swahili
Education: Bachelor’s in CS
Socioeconomic Background: Rural, low-income
Years of Experience: 5
Primary Language: Kotlin, Dart
Employer: Non-Profit (HealthTech)
Industry: Mobile Health Apps
Personality: INFJ (Idealist, empathetic)
Motivation: "Tech for equitable healthcare."

Persona 9: The Cybersecurity Contractor
Age: 34
Gender: Male
Race/Ethnicity: Middle Eastern (Israeli)
Location: Tel Aviv, Israel
Native Language: Hebrew
Education: Bachelor’s in Cybersecurity
Socioeconomic Background: Upper-middle-class
Years of Experience: 10
Primary Language: Python, Go
Employer: Freelance (Security Audits)
Industry: Cybersecurity
Personality: INTJ (Mastermind, paranoid)
Motivation: "Break things before attackers do."

Persona 10: The Tech Educator & MOOC Creator
Age: 40
Gender: Non-binary
Race/Ethnicity: White (Canadian)
Location: Toronto, Canada
Native Language: English
Education: Master’s in Education + Bootcamp
Socioeconomic Background: Middle-class
Years of Experience: 8
Primary Language: JavaScript, Python
Employer: EdTech Platform
Industry: Online Education
Personality: ESFJ (Teacher, community-driven)
Motivation: "Democratize coding education."