Marketing Analytics Project Guide

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AI Tools Usage Research at BITS Pilani Campus

A Comprehensive Methodology for Clustering, Discriminant Analysis & Perceptual Mapping

Executive Summary

This guide provides a complete framework for conducting a marketing analytics research project focused on understanding AI tool adoption, usage patterns, and preferences among students at educational institutions like BITS Pilani. The methodology integrates qualitative research, quantitative surveys, and three advanced analytical techniques: **Clustering Analysis**, **Discriminant Analysis**, and **Perceptual/Preference Mapping**.

Project Scope: Understanding how students use AI tools (ChatGPT, GitHub Copilot, Gemini, Claude, Grammarly) in academic work, identifying distinct user segments, determining adoption drivers, and mapping competitive positioning.

Timeline: 12-16 weeks from initial interviews to final recommendations

Target Sample: 15-20 qualitative interviews, 200-300 quantitative survey responses

Phase 1: Preliminary Research & Problem Definition

Step 1.1: Qualitative Data Collection

Objective: Conduct in-depth interviews to understand current AI usage patterns and explore student perspectives.

Key Actions:

- Design interview protocol based on 10 core questions
- Recruit 15-20 students across different disciplines and years
- Ensure diverse sample: heavy users, moderate users, light users, non-users
- Record sessions with informed consent
- Conduct 30-45 minute semi-structured interviews

Interview Questions Framework:

1. **Usage Frequency:** "Do you use AI tools (like ChatGPT, CoPilot, Gemini, etc.) in academic work and how often?"
    - *Probe:* Which specific tools? How many hours per week?
2. **Tool Diversity:** "Do you use only one tool or multiple?"
    - *Probe:* What made you choose multiple tools?

3. **Feature Value:** "What specific features or functionalities is most useful to you and your work?"
    - *Probe:* Can you give an example of how you use this feature?
4. **Tool-Task Fit:** "Can you tell us about different tools and the specific reason for using each one of them?"
    - *Probe:* Do different tools serve different purposes?
5. **Challenges:** "Do you face challenges with a particular AI tool or across multiple tools?"
    - *Probe:* How do you work around these challenges?
6. **Evolution:** "How would you say your usage has changed over time?"
    - *Probe:* What triggered the change in your usage?
7. **Decision Criteria:** "Will you change your preferences based on functionalities or work with whatever is handy for a particular task?"
    - *Probe:* What factors influence your choice in the moment?
8. **Barriers:** "Is there some factor or reason that stops you from using an AI tool (if any)?"
    - *Probe:* What would need to change for you to use it more?
9. **Customization Preference:** "Would you prefer tools that are customized as agents to serve your work needs over commonly used generative ones like ChatGPT or Gemini?"
    - *Probe:* What would a customized tool look like for you?
10. **Learning Outcomes:** "What learning outcomes have these AI tools helped you achieve and do they differ in delivering those outcomes?"
    - *Probe:* Can you share a specific example of learning improvement?

Best Practices:

- Create comfortable interview environment
- Practice active listening
- Allow natural conversation flow while covering all questions
- Take detailed notes even with recording
- Observe non-verbal cues and emotional responses

Deliverable: Raw interview recordings with metadata (date, duration, participant demographics)

Estimated Time: 2-3 weeks

Step 1.2: Interview Transcription

Objective: Convert audio recordings into analyzable text format.

Key Actions:

- Use intelligent verbatim transcription approach
- Leverage AI transcription tools (Otter.ai, Rev, Descript) for efficiency
- Conduct human review for accuracy and context
- Remove excessive filler words but maintain speaker's meaning
- Capture important non-verbal elements (laughter, pauses, emphasis)
- Document metadata for each transcript

Transcription Guidelines:

- **Clean but Accurate:** Remove "um," "uh," repetitions, but keep meaningful hesitations
- **Context Preservation:** Note significant emotional expressions
- **Anonymization:** Replace identifying information with codes (Student_01, Student_02)
- **Formatting:** Use consistent speaker labels and timestamp key moments

Quality Checks:

- Spot-check 20% of transcripts against audio
- Verify technical terms are correctly captured
- Ensure speaker identifications are consistent

Deliverable: Complete set of transcribed interviews with quality assurance documentation

Estimated Time: 1 week (with AI assistance)

Step 1.3: Research Gap Analysis

Objective: Identify patterns, themes, and knowledge gaps through systematic analysis of interview data.

Key Actions:

- Apply thematic analysis methodology
- Develop coding framework (deductive and inductive codes)
- Identify recurring themes and patterns
- Create preliminary student personas
- Map what is known vs. what remains unexplored

Thematic Coding Process:

1. **Familiarization:** Read all transcripts multiple times
2. **Initial Coding:** Generate codes for interesting features
3. **Theme Development:** Collate codes into potential themes
4. **Theme Review:** Refine and define clear themes
5. **Report Writing:** Select compelling examples for each theme

Expected Themes:

- **Adoption Patterns:** Frequency, tool selection, evolution over time
- **Usage Contexts:** Academic tasks, creative work, research, coding
- **Valued Features:** Ease of use, accuracy, speed, personalization
- **Barriers:** Privacy concerns, trust issues, ethical dilemmas, cost, learning curve
- **Outcomes:** Time savings, learning efficiency, grade impact, skill development

Persona Development:

Power Users (25%):

- Daily usage, multiple tools (3-5)
- High technical comfort
- Diverse use cases (coding, writing, research)
- Early adopters, experiment with new features
- Concerns: Over-reliance, verification needed

Pragmatic Adopters (45%):

- Regular usage (2-3 times/week), 1-2 tools
- Moderate technical comfort
- Task-specific usage (assignments, summaries)
- Selective adoption based on proven value
- Concerns: Accuracy for critical work

Cautious Users (20%):

- Occasional usage, typically one tool

- Low-moderate technical comfort
- Basic queries only
- Trust concerns, prefer verification
- Concerns: Academic integrity, privacy

Non-Adopters (10%):

- Rarely/never use AI tools
- Variable technical comfort
- Ethical concerns or lack of awareness
- Prefer traditional learning methods
- Concerns: Cheating implications, loss of learning

Research Gaps to Identify:

- Relationship between discipline and adoption
- Impact of institutional support on usage
- Differences in learning outcomes by user type
- Role of peer influence in adoption
- Factors predicting tool switching behavior

Deliverable: Comprehensive research gap analysis report with identified themes, personas, and specific research questions for quantitative phase

Estimated Time: 1-2 weeks

Step 1.4: Problem Statement Formation

Objective: Translate qualitative insights into specific, measurable research questions for survey phase.

Key Actions:

- Formulate clear research objectives
- Define testable hypotheses
- Identify key variables to measure
- Ensure alignment with planned analytical techniques
- Validate with stakeholders (faculty advisors, potential users)

Research Questions Framework:

Primary Research Question:
"What are the distinct patterns of AI tool adoption among BITS Pilani students, and what factors predict segment membership?"

Secondary Research Questions:

1. How do students segment based on AI tool usage patterns? (Clustering)
2. Which demographic, behavioral, and attitudinal variables best predict segment membership? (Discriminant Analysis)
3. How do students perceive different AI tools in terms of key attributes? (Perceptual Mapping)
4. What are students' ideal tool characteristics? (Preference Mapping)
5. What barriers prevent broader adoption across segments?

Hypotheses to Test:

- H1: Students will segment into 4-5 distinct clusters based on usage patterns
- H2: Technical comfort level will be the strongest predictor of segment membership
- H3: STEM students will show higher adoption rates than non-STEM students
- H4: ChatGPT will be perceived as easiest to use but not most feature-rich

- H5: Privacy concerns will be the primary barrier for non-adopters

Variable Mapping:

Dependent Variables:

- Cluster membership (for discriminant analysis)
- Tool preference ratings (for perceptual mapping)

Independent Variables:

- Demographics: Year, discipline, age, gender
- Usage: Frequency, tools used, time spent, purposes
- Perceptions: Ease of use, usefulness, trust, satisfaction
- Attitudes: Perceived benefits, concerns, willingness to pay
- Barriers: Privacy, cost, ethics, technical difficulty

Alignment with Analyses:

- **Clustering:** Will use usage frequency, tool diversity, time spent, comfort level, purposes as clustering variables
- **Discriminant:** Will test demographics, perceptions, and attitudes as predictors of cluster membership
- **Perceptual Mapping:** Will use attribute ratings (ease, features, trust, cost) to position tools and identify preferences

Deliverable: Formalized problem statement document with research questions, hypotheses, and variable definitions

Estimated Time: 3-5 days

Phase 2: Survey Design & Data Collection

Step 2.1: Questionnaire Development

Objective: Design comprehensive survey instrument that captures all necessary data for the three analyses.

Survey Structure:

Section 1: Demographics (4-5 questions)

- Year of study (Freshman/Sophomore/Junior/Senior/Graduate)
- Academic discipline (Engineering/Sciences/Business/Humanities/Other)
- Gender (Male/Female/Non-binary/Prefer not to say)
- Age range (18-20/21-23/24-26/27+)
- Technical proficiency self-assessment (1-5 scale)

Section 2: AI Tool Usage (8-10 questions)

- **Frequency:** "How often do you use AI tools for academic work?"
  - Never / Rarely (monthly) / Sometimes (weekly) / Often (2-3x/week) / Always (daily)
- **Tool Selection:** "Which of the following AI tools have you used? (Select all)"
  - ChatGPT, GitHub Copilot, Google Gemini, Claude, Grammarly, Perplexity, Other
- **Time Allocation:** "What percentage of your study time involves using AI tools?"
  - 0-25% / 26-50% / 51-75% / 76-100%
- **Primary Purposes:** "For what purposes do you use AI tools? (Select all)"
  - Assignment help, Concept explanation, Code writing, Research, Writing assistance, Summarization, Translation, Other
- **Duration:** "How long have you been using AI tools for academic work?"
  - Never used / <3 months / 3-6 months / 6-12 months / >1 year

Section 3: Tool Perceptions (12-15 questions)

For each major tool (ChatGPT, Copilot, Gemini, Claude, Grammarly), rate on 1-5 scale:

- **Ease of Use:** "Rate the ease of use of [Tool]"
  - 1=Very Difficult to 5=Very Easy
- **Feature Power:** "Rate the capabilities/features of [Tool]"
  - 1=Very Limited to 5=Very Advanced
- **Reliability/Trust:** "How much do you trust [Tool]'s outputs?"
  - 1=Don't Trust to 5=Completely Trust
- **Value for Money:** "Rate the cost-value relationship of [Tool]"
  - 1=Not Worth It to 5=Excellent Value
- **Overall Satisfaction:** "Overall, how satisfied are you with [Tool]?"
  - 1=Very Dissatisfied to 5=Very Satisfied

Section 4: Preferences & Barriers (8-10 questions)

- **Feature Importance:** "Rank these characteristics by importance" (Drag-and-drop)
  - Ease of use, Accuracy, Speed, Privacy, Cost, Features, Customer support
- **Ideal Tool:** "Describe your ideal AI tool for academic work" (Open-ended)
- **Barriers:** "What prevents you from using AI tools more? (Select all)"
  - Privacy concerns, Cost, Ethical concerns, Don't know how, Accuracy issues, Academic integrity, Time to learn, Not allowed
- **Willingness to Pay:** "Would you pay for premium AI tool features?"
  - Definitely not / Probably not / Maybe / Probably yes / Definitely yes

Section 5: Outcomes & Impact (6-8 questions)

Rate agreement on 1-5 scale (Strongly Disagree to Strongly Agree):

- "AI tools have improved my learning efficiency"
- "AI tools have helped me understand concepts better"
- "My grades have improved since using AI tools"
- "AI tools have saved me significant time"
- "I feel more confident in my work using AI tools"
- "AI tools have helped me develop new skills"

Open-ended: "Share one specific example of how AI tools have helped your learning"

Survey Design Best Practices:

1. **Logical Flow:** Start with easy demographics, build to specific usage, end with attitudes
2. **Question Types:** Mix Likert scales, multiple choice, rankings, and open-ended
3. **Length:** Target 10-15 minutes (30-40 questions maximum)
4. **Clarity:** Use simple, unbiased language; avoid jargon
5. **Validation:** Include attention check questions
6. **Mobile-Friendly:** Ensure survey works on all devices
7. **Incentivization:** Consider offering incentives for completion

Pre-Testing:

- Test with 10-15 students from target population
- Collect feedback on clarity, length, flow
- Check for technical issues

- Revise based on feedback
- Calculate estimated completion time

Deliverable: Finalized, pre-tested survey instrument on platform (Google Forms, Qualtrics, SurveyMonkey)

Estimated Time: 1-2 weeks

Step 2.2: Survey Distribution

Objective: Reach target sample size with representative distribution across key demographics.

Target Sample:

- **Minimum:** 200 responses (for statistical power)
- **Target:** 250-300 responses (for robust clustering)
- **Stratification:** Proportional to campus distribution by year and discipline

Distribution Strategy:

1. **Official Channels:**
    - Student email lists (with institutional approval)
    - Learning management systems (Moodle, Canvas)
    - Student portal announcements
2. **Social Channels:**
    - WhatsApp groups (year-wise, discipline-wise)
    - Facebook student groups
    - Instagram stories and posts
    - LinkedIn student network
3. **Physical Channels:**
    - QR codes on campus posters
    - Announcements in classes (with professor permission)
    - Library and common area displays

Distribution Timeline:

- Week 1: Initial launch via all channels
- Day 3-4: First reminder via email and social media
- Week 2: Targeted outreach to underrepresented groups
- Day 10-11: Second reminder emphasizing deadline
- Week 3: Final push with extended deadline if needed

Incentivization Strategy:

- Raffle for prizes (e.g., 5 x ₹500 Amazon vouchers)
- Entry into draw for participation
- Course credit (if approved by instructors)
- Aggregate results shared with participants

Monitoring:

- Daily response rate tracking
- Demographic distribution monitoring
- Completion rate analysis
- Drop-off point identification
- Adjust strategy based on data

Quality Control During Collection:

- Monitor for duplicate responses (IP, email)
- Check for suspiciously fast completions (<4 minutes)
- Review open-ended responses for quality
- Track response rates by distribution channel

Deliverable: Target sample size achieved with representative distribution

Estimated Time: 2-3 weeks

Step 2.3: Data Collection & Validation

Objective: Ensure high-quality, clean dataset ready for statistical analysis.

Data Validation Process:

1. Completeness Checks:

- Remove responses with <80% completion
- Identify and handle missing data patterns
- Decide on missing data strategy (deletion vs. imputation)

2. Quality Screening:

- **Speeders:** Remove responses completed in <4 minutes (below reasonable time)
- **Straight-lining:** Flag responses with same answer for 10+ consecutive questions
- **Attention Checks:** Remove respondents who fail attention check questions
- **Open-ended Quality:** Review text responses for gibberish or copy-paste

3. Duplicate Detection:

- Check for multiple submissions from same IP/email
- Keep first submission, remove duplicates
- Document duplicate removal decisions

4. Outlier Analysis:

- Identify statistical outliers in continuous variables
- Investigate extreme values (e.g., 100% study time on AI)
- Decide on retention vs. removal based on validity

5. Demographic Validation:

- Compare sample distribution to campus population
- Check for overrepresentation/underrepresentation
- Consider weighting if needed for analyses

Data Cleaning:

- Recode variables as needed for analysis
- Create computed variables (e.g., total tools used)
- Label all variables and values clearly
- Document all cleaning decisions in codebook

Dataset Export:

- SPSS format (.sav) for discriminant analysis
- CSV for Python/R clustering and perceptual mapping
- Excel backup for manual review

Final Quality Report:

- Initial responses: [N]
- Removed (incomplete): [N]
- Removed (quality): [N]
- Final valid responses: [N]
- Response rate: [%]
- Demographic distribution table

Deliverable: Clean, validated dataset with complete documentation and codebook

Estimated Time: 3-5 days

Phase 3: Advanced Data Analysis

Step 3.1: Clustering Analysis

Objective: Identify distinct student segments based on AI tool usage patterns and behaviors.

Methodology:

Variable Selection:
Choose variables that capture usage patterns:

- Usage frequency (ordinal: 1-5)
- Number of tools used (count: 0-7)
- Time spent on AI tools (ordinal: 1-4 for quartiles)
- Technical comfort level (scale: 1-5)
- Purposes diversity (count of purposes selected)

Data Preparation:

- Standardize all variables (z-scores) for equal weighting
- Handle missing data (mean imputation or deletion)
- Check for multicollinearity among clustering variables

Algorithm Selection:

1. K-Means Clustering

- *Best for:* Large datasets, spherical clusters expected
- *Process:* Partition data into K clusters minimizing within-cluster variance
- *Advantages:* Fast, scalable, easy to interpret
- *Disadvantages:* Must specify K upfront, sensitive to outliers

2. Hierarchical Clustering

- *Best for:* Exploring cluster structure, smaller datasets
- *Process:* Build dendrogram showing cluster relationships
- *Advantages:* Visual representation, no need to pre-specify K
- *Disadvantages:* Computationally expensive, can't modify once merged

3. DBSCAN

- *Best for:* Arbitrary cluster shapes, outlier detection
- *Process:* Density-based clustering identifying core, border, and noise points
- *Advantages:* Finds outliers, flexible cluster shapes
- *Disadvantages:* Requires parameter tuning (epsilon, minPts)

Determining Optimal Number of Clusters:

Elbow Method:

- Plot within-cluster sum of squares (WCSS) vs. K
- Look for "elbow" where marginal improvement diminishes
- Typically identifies 3-5 clusters for this data

Silhouette Score:

- Measures how similar objects are to their own cluster vs. other clusters
- Range: -1 to +1 (higher is better)
- Good clustering: Average silhouette > 0.5

Gap Statistic:

- Compares within-cluster dispersion to null reference distribution
- Optimal K maximizes gap statistic
- Provides statistical justification for K selection

Expected Results:

Cluster 1: Power Users (20-30%)

- Profile: Daily usage, 3-5 tools, high comfort (8-9/10)
- Characteristics: Early adopters, diverse use cases, high trust
- Tools: ChatGPT, Copilot, Grammarly, Claude
- Time: >50% study time involves AI
- Needs: Advanced features, customization, integration

Cluster 2: Pragmatic Adopters (40-50%)

- Profile: Regular usage (2-3x/week), 1-2 tools, moderate comfort (5-7/10)
- Characteristics: Selective adoption, proven value, task-specific
- Tools: Primarily ChatGPT, possibly one specialist tool
- Time: 25-50% study time involves AI
- Needs: Reliability, ease of use, accuracy

Cluster 3: Cautious Users (15-25%)

- Profile: Occasional usage, 1 tool, low-moderate comfort (3-5/10)
- Characteristics: Trust concerns, verification needed, ethical awareness
- Tools: ChatGPT for basic queries only
- Time: <25% study time involves AI
- Needs: Trust-building, privacy assurance, guidance

Cluster 4: Non-Adopters (5-15%)

- Profile: Rarely/never use, high ethical concerns, variable comfort
- Characteristics: Prefer traditional methods, academic integrity concerns
- Tools: None or extremely rare use
- Time: ~0% study time involves AI
- Needs: Education on ethical use, clear policies, value demonstration

Cluster Validation:

- Internal validation: Silhouette coefficient, Dunn index
- External validation: Compare with known groupings (if available)
- Stability: Rerun with different random seeds, check consistency

- Face validity: Do clusters make theoretical sense?

Cluster Profiling:
For each cluster, analyze:

- Demographics (year, discipline, age, gender)
- Usage patterns (frequency, tools, purposes, time)
- Perceptions (ease, usefulness, trust, satisfaction)
- Barriers (primary concerns preventing more use)
- Outcomes (perceived learning impact, grade change)

Visualization:

- 2D/3D scatter plots (using PCA for dimension reduction)
- Radar charts showing cluster profiles on key dimensions
- Heatmaps of cluster characteristics
- Cluster size pie chart with percentages

Deliverable: Student segmentation with detailed cluster profiles, validation metrics, and visualizations

Estimated Time: 1 week

Tools: Python (scikit-learn), R (cluster, factoextra), SPSS, Tableau/Power BI

Step 3.2: Discriminant Analysis

Objective: Identify which variables best distinguish between the student segments and build a classification model.

Methodology:

Setup:

- Dependent Variable: Cluster membership (4 groups from previous step)
- Independent Variables: Demographics, perceptions, attitudes, barriers

Variable Selection:

Predictor Variables to Test:

- **Demographics:** Year, discipline (STEM/non-STEM), age, gender, technical proficiency
- **Perceptions:** Average ease rating, average usefulness rating, trust level
- **Attitudes:** Perceived benefit, willingness to pay, concern level
- **Barriers:** Number of barriers selected, specific barrier types
- **External:** Peer influence, institutional support, prior experience

Assumptions Testing:

1. **Sample Size:** At least 20 observations per predictor variable ✓
2. **Multicollinearity:** VIF < 10 for all predictors
3. **Normality:** Predictors approximately normally distributed within groups
4. **Homogeneity of Variance:** Box's M test ($p > 0.001$)
5. **Outliers:** Identify and handle multivariate outliers

Analysis Process:

1. Discriminant Function Calculation:

- For K groups, up to K-1 discriminant functions can be derived
- For 4 clusters, we'll get 3 discriminant functions
- Functions are linear combinations of predictors that maximize group separation

Discriminant Function:

$$D = b_0 + b_1X_1 + b_2X_2 + \ldots + b_pX_p$$

Where:

- D = discriminant score
- b_i = discriminant coefficient for predictor i
- X_i = value of predictor i

2. Function Significance:

- Wilks' Lambda (Λ): Measures variance unexplained by groups (0-1, lower is better)
- Chi-square test: Tests significance of each function
- Eigenvalue: Ratio of between-group to within-group variance

3. Variable Importance:

- Standardized discriminant coefficients: Show relative importance
- Structure correlations: Correlation between predictor and discriminant function
- Identify top 5-10 most important predictors

Expected Key Discriminators:

1. **Technical Comfort Level** (β ≈ 0.85)
   - Strongest predictor; higher comfort → higher adoption cluster
2. **Academic Discipline** (β ≈ 0.72)
   - STEM students more likely in Power User/Pragmatic clusters
3. **Prior Coding Experience** (β ≈ 0.68)
   - Experience with tech tools predicts AI adoption
4. **Perceived Usefulness** (β ≈ 0.65)
   - Higher perceived usefulness → more active adoption
5. **Year of Study** (β ≈ 0.58)
   - Senior students more likely to be Power Users

Classification:

Classification Process:

1. For each individual, calculate discriminant scores on all functions
2. Assign to group with highest posterior probability
3. Compare predicted to actual cluster membership

Classification Matrix (Confusion Matrix):

```
                Predicted Group
Actual      | Power | Pragmatic | Cautious | Non-Adopt
-----------------------------------------------------
Power       |   85  |     12    |     3    |     0
Pragmatic   |   15  |    110    |    20    |     5
Cautious    |    2  |     18    |    35    |     5
Non-Adopt   |    0  |      5    |     8    |    12
```

Performance Metrics:

- **Overall Accuracy:** 75-85% expected (excellent if >80%)
- **Precision by Cluster:** TP / (TP + FP)
- **Recall by Cluster:** TP / (TP + FN)
- **F1-Score:** Harmonic mean of precision and recall

Cross-Validation:

- Split data 70% training, 30% holdout
- Build model on training, test on holdout
- Compare accuracy between training and holdout
- K-fold cross-validation for robust estimate

Interpretation:

Function 1 (explains most variance):

- Likely separates Non-Adopters and Cautious from Power Users and Pragmatic
- Key discriminators: Technical comfort, perceived usefulness

Function 2:

- Likely separates Power Users from Pragmatic Adopters
- Key discriminators: Number of tools, time spent, purposes diversity

Function 3:

- May separate Cautious Users from Non-Adopters
- Key discriminators: Barriers, attitudes toward AI

Practical Application:
"A new student entering BITS Pilani can be classified into one of the four segments with 82% accuracy by assessing their technical comfort (strongest predictor), academic discipline, and prior tech experience."

Visualization:

- Canonical discriminant function plot (2D showing separation)
- Variable importance bar chart
- Classification accuracy heatmap
- ROC curves for each cluster

Deliverable: Discriminant functions, classification model, variable importance rankings, confusion matrix, and interpretation guide

Estimated Time: 1 week

Tools: SPSS (most common for DA), R (MASS package), Python (scikit-learn LDA/QDA)

Step 3.3: Perceptual and Preference Mapping

Objective: Visualize how students perceive different AI tools and identify preference patterns.

Methodology:

Part A: Perceptual Mapping (External)

Data Collection:
From survey, we have ratings (1-5) for each tool on:

- Ease of Use
- Feature Power/Capabilities
- Reliability/Trust
- Value for Money
- Overall Satisfaction

Multidimensional Scaling (MDS):

Process:

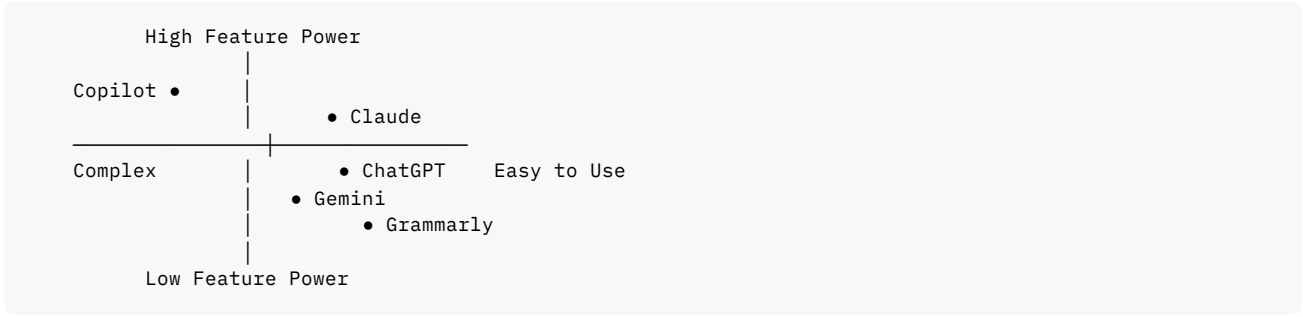
1. Calculate similarity/dissimilarity matrix between tools

2. Apply MDS algorithm to reduce to 2-3 dimensions
3. Position tools in perceptual space based on attribute ratings

Dimension Interpretation:

- **Dimension 1 (Horizontal):** Typically represents Ease of Use (Simple ↔ Complex)
- **Dimension 2 (Vertical):** Typically represents Feature Power (Basic ↔ Advanced)

Expected Tool Positioning:



Tool Clusters:

- **General Purpose Leaders:** ChatGPT, Gemini (easy, moderately powerful)
- **Writing Specialists:** Grammarly (easy, focused features)
- **Developer Tools:** Copilot (complex, very powerful)
- **Balanced Performers:** Claude (moderate on both)

Quadrant Analysis:

1. **Top-Right (Ideal Zone):** Easy & Powerful
   - ChatGPT likely positioned here
   - High preference, strong market position
2. **Top-Left:** Complex but Powerful
   - Copilot likely here
   - Valued by advanced users (Power Users cluster)
3. **Bottom-Right:** User-Friendly but Basic
   - Grammarly potentially here
   - Good for specific tasks, limited scope
4. **Bottom-Left:** Complex and Limited
   - Avoid this quadrant (no tools expected)
   - Represents market weakness

Part B: Preference Mapping (Internal)

MDPREF (Multidimensional Analysis of Preference Data):

Process:

1. Use preference ratings or rankings from survey
2. Overlay student preferences on perceptual map
3. Identify preference vectors or ideal points

Preference Vector Approach:

- Each student (or cluster) has a vector indicating direction of increasing preference
- Vector direction shows which attributes drive that student's preferences
- Vector length shows how well perceptions explain preferences

Ideal Point Approach:

- Each student (or cluster) has an ideal point in perceptual space
- Tool closest to ideal point is most preferred
- Distance from ideal indicates satisfaction potential

Expected Patterns by Cluster:

Power Users:

- Ideal point: High features, moderate ease (top-center)
- Preference vector: Points toward top-left (prioritize features over ease)
- Most prefer: Claude, ChatGPT Plus, Copilot

Pragmatic Adopters:

- Ideal point: Moderate features, high ease (right-center)
- Preference vector: Horizontal (prioritize ease of use)
- Most prefer: ChatGPT, Gemini

Cautious Users:

- Ideal point: Low features, high ease (bottom-right)
- Preference vector: Points right (strongly prioritize ease)
- Most prefer: Grammarly, basic ChatGPT

Analysis by Attributes:

Attribute Importance:

- Calculate correlation between each attribute and overall preference
- Identify which dimensions drive preference most
- Typical finding: Ease of use may be stronger driver than feature power for most students

Market Gaps:

- Are there areas in perceptual space with no tools but high preference?
- Example: High-trust, education-specific tools may be desired but not exist

Strategic Implications:

For Tool Developers:

- ChatGPT: Maintain ease, add more advanced features to move up
- Copilot: Improve onboarding to increase ease perception
- Gemini: Differentiate from ChatGPT, emphasize unique strengths
- New Tools: Target underserved quadrants (e.g., easy + advanced)

For Institutions:

- Focus training on tools in "ideal zone" (high preference)
- Provide support for powerful tools to reduce perceived complexity
- Address concerns about reliability/trust for all tools

Visualization:

1. **Basic Perceptual Map:** 2D scatter with tools labeled
2. **Preference Vector Map:** Same map with arrows showing preference directions by cluster
3. **Ideal Point Map:** Perceptual map with ideal points marked as stars
4. **Attribute Biplot:** Shows correlation of attributes with dimensions

Statistical Validation:

- Stress value for MDS (< 0.2 is good fit)

- R^2 for preference model (how well perceptions predict preferences)
- Cross-validation of ideal point predictions

Deliverable: Perceptual maps, preference maps, interpretation of tool positioning, strategic implications, and visualizations

Estimated Time: 1 week

Tools: R (PREFMAP, smacof packages), XLSTAT, Python (scikit-learn MDS, matplotlib), Tableau

Phase 4: Insights & Recommendations

Step 4.1: Data Visualization

Objective: Create comprehensive, interactive dashboard presenting all findings in accessible format.

Dashboard Design Principles:

1. Visual Hierarchy:

- Top section: Key metrics and headline findings
- Middle: Core visualizations (clusters, discriminant, perceptual maps)
- Bottom: Detailed breakdowns and filters

2. Information Architecture:

Landing View:

- Total sample size
- Number of clusters identified
- Classification accuracy
- Most used tool
- Key insight callouts

Clustering View:

- Scatter plot of clusters (PCA dimensions)
- Cluster size pie chart
- Radar chart of cluster profiles
- Demographic breakdown by cluster
- Filters: Year, discipline, comfort level

Discriminant Analysis View:

- Variable importance bar chart (top 10 predictors)
- Classification accuracy heatmap
- Canonical discriminant function plot
- Prediction tool: Input variables → predict segment

Perceptual Mapping View:

- 2D perceptual map with tool positioning
- Preference vectors by cluster
- Ideal point markers
- Attribute importance rankings
- Interactive: Click tool to see detailed profile

Comparative View:

- Tool comparison table (all attributes)

- Usage statistics by tool
- Satisfaction scores comparison
- Recommendation matrix: Which tool for which purpose

Insights View:

- Key findings summary
- Surprising patterns
- Segment-specific insights
- Barrier analysis
- Recommendations preview

3. Chart Selection:

Data Type	Chart Type	Purpose
Cluster composition	Pie chart	Show relative sizes
Cluster profiles	Radar chart	Compare across dimensions
Cluster visualization	Scatter plot	Show group separation
Variable importance	Horizontal bar	Rank predictors
Classification accuracy	Heatmap	Show confusion matrix
Perceptual positioning	2D scatter	Map tool perceptions
Tool comparisons	Grouped bar	Compare multiple attributes
Trends over time	Line chart	Show usage evolution
Distributions	Histogram	Show frequency patterns

4. Interactivity:

- Filters: Segment, year, discipline, tool
- Tooltips: Hover for detailed information
- Drill-down: Click for deeper analysis
- Cross-filtering: Selection in one chart filters others
- Export: Download charts and data

5. Color Consistency:

- Cluster colors: Blue (Power), Purple (Pragmatic), Pink (Cautious), Red (Non-Adopt)
- Tool colors: Unique color per tool, maintained across all views
- Sentiment colors: Green (positive), Yellow (neutral), Red (negative)
- Accessibility: Colorblind-safe palette (ColorBrewer)

6. Responsive Design:

- Desktop: Multi-panel layout
- Tablet: Stacked panels with tabs
- Mobile: Vertical scroll, simplified charts

Best Practices:

- ✓ 3-5 second rule: Key insight visible immediately
- ✓ Data-ink ratio: Minimize non-data elements
- ✓ Consistent formatting: Same fonts, sizes, spacing

- ✓ White space: Don't cram, let visualizations breathe
- ✓ Annotations: Label important points and trends
- ✓ Context: Always include sample size, dates, definitions

Deliverable: Interactive, multi-view dashboard with all key visualizations, filters, and export capabilities

Estimated Time: 1-2 weeks

Tools: Tableau, Power BI, Python (Plotly Dash), R Shiny

Step 4.2: Insight Generation

Objective: Translate statistical findings into meaningful, actionable business insights.

Insight Framework:

1. Segment Insights:

Power Users (25% of students):

- Characteristics: Daily users, 3-5 tools, high technical comfort
- Behaviors: Use AI for diverse purposes, early adopters, high trust
- Needs: Advanced features, customization, seamless integration
- Barriers: Over-reliance concerns, need for verification
- Opportunity: Pilot program for advanced features, beta testers

Pragmatic Adopters (45% of students):

- Characteristics: Regular users, 1-2 tools, moderate comfort
- Behaviors: Task-specific usage, proven value required
- Needs: Reliability, accuracy, ease of use
- Barriers: Trust for critical work, learning curve for new tools
- Opportunity: Main target for training programs, feature education

Cautious Users (20% of students):

- Characteristics: Occasional users, typically one tool, trust concerns
- Behaviors: Basic queries only, extensive verification
- Needs: Privacy assurance, trust-building, ethical guidelines
- Barriers: Academic integrity concerns, privacy fears
- Opportunity: Education on ethical use, clear policies

Non-Adopters (10% of students):

- Characteristics: Rare/no use, ethical concerns dominant
- Behaviors: Prefer traditional methods, skeptical of value
- Needs: Demonstration of value, ethical framework, peer examples
- Barriers: Fundamental concerns about AI in education
- Opportunity: Gradual introduction, addressing core concerns

2. Discriminant Analysis Insights:

Top Predictors of Adoption:

1. **Technical Comfort Level (β=0.85):**
    - *Insight:* Technical self-efficacy is the strongest predictor of AI adoption
    - *Implication:* Building technical confidence is key to broader adoption
    - *Action:* Develop confidence-building workshops, not just tool training

2. **Academic Discipline (β=0.72):**
    - *Insight:* STEM students 2.5x more likely to be Power Users than humanities
    - *Implication:* Discipline-specific approaches needed
    - *Action:* Tailor training content to discipline use cases
3. **Prior Coding Experience (β=0.68):**
    - *Insight:* Students with programming experience more comfortable with AI
    - *Implication:* Exposure to tech tools lowers barriers
    - *Action:* Introduce basic coding literacy campus-wide
4. **Perceived Usefulness (β=0.65):**
    - *Insight:* When students see value, they adopt regardless of technical comfort
    - *Implication:* Demonstrating practical value can overcome barriers
    - *Action:* Create showcase of successful use cases by discipline

Classification Power:

- Model can predict segment membership with 82% accuracy
- Means we can identify students at risk of being left behind
- Can target interventions to specific student profiles

3. Perceptual Mapping Insights:

Tool Positioning:

- **ChatGPT:** Positioned as easiest to use and most feature-rich (ideal zone)
    - *Market leader, sets standard for category*
    - Concern: May become generic term (like "Google" for search)
- **GitHub Copilot:** High features but lower ease perception
    - *Valued by Power Users, intimidating to others*
    - Opportunity: Improve onboarding and discoverability
- **Gemini:** Similar to ChatGPT but slightly less preferred
    - *Struggling to differentiate from ChatGPT*
    - Challenge: Needs unique value proposition
- **Claude:** Balanced features and ease
    - *Emerging as preferred tool for analysis and writing*
    - Opportunity: Focus on depth and reliability positioning
- **Grammarly:** Easy but limited to writing
    - *Specialist tool, not general AI assistant*
    - Position: Complementary tool, not replacement for ChatGPT

Preference Patterns:

- Most students prioritize ease over features (70% weight vs. 30%)
- Trust/reliability increasingly important (third most important)
- Cost is barrier only for premium features, free tier sufficient for most

Market Gaps:

- Desire for education-specific AI tools (high trust, curriculum-aligned)
- Underserved: Easy-to-use tools with advanced academic features
- Opportunity for new entrants: Privacy-focused, institution-certified tools

4. Barrier Analysis:

Top Barriers by Frequency:

1. Privacy concerns (48% of students)
2. Accuracy/reliability issues (42%)
3. Academic integrity concerns (38%)
4. Don't know how to use effectively (32%)
5. Cost of premium features (28%)

Barrier Patterns by Segment:

- Power Users: Over-reliance, verification time
- Pragmatic: Accuracy for critical work
- Cautious: Privacy, ethical concerns
- Non-Adopters: Academic integrity, philosophical opposition

5. Surprising Findings:

- **Finding:** 23% of Power Users report lower grades since starting AI use
  - *Hypothesis:* Over-reliance reducing deep learning
  - *Implication:* Need guidelines on appropriate use levels
- **Finding:** Non-STEM students who adopt become Power Users at same rate as STEM
  - *Hypothesis:* Barrier is initial adoption, not sustained use
  - *Implication:* Focus on initial exposure, not ongoing support
- **Finding:** Peer influence ranks low (6th) as predictor
  - *Hypothesis:* AI adoption is individual decision, not social
  - *Implication:* Peer campaigns less effective than individual outreach

6. Trend Insights:

Usage Evolution (from qualitative):

- 76% report increased usage over past 6 months
- Average time spent on AI: 15% of study time in 2023 → 28% in 2024
- Tool diversity: Students starting with ChatGPT, adding specialist tools

Temporal Patterns:

- Spike in usage during: Assignment deadlines, exam prep, project work
- Lower during: Breaks, routine coursework, initial concept learning

Deliverable: Comprehensive insights report synthesizing all analyses with specific, quantified findings and strategic implications

Estimated Time: 1 week

Step 4.3: Strategic Recommendations

Objective: Develop actionable, prioritized recommendations for key stakeholders.

Recommendations for BITS Pilani Administration:

1. Develop Comprehensive AI Literacy Program (High Priority)

Rationale: Technical comfort is strongest predictor of adoption; 32% don't know how to use AI effectively

Recommendations:

- **Freshman Orientation Module:** 2-hour introduction to AI tools in academics
  - Hands-on workshop with common academic tasks
  - Ethical use guidelines and academic integrity policies
  - Tool demonstrations: ChatGPT, Grammarly basics

- **Discipline-Specific Workshops:** Tailored training by department
  - Engineering: Copilot for coding, AI in design
  - Sciences: Research assistance, literature review
  - Business: Market analysis, case preparation
  - Humanities: Writing assistance, research
- **Advanced User Certification:** For Power Users
  - Advanced techniques, prompt engineering
  - Ethical considerations, bias awareness
  - Become peer mentors

Success Metrics:

- 80% of freshmen complete orientation within first month
- Technical comfort scores increase by 30% post-workshop
- 50% of students report improved AI usage effectiveness

2. Establish Clear AI Usage Policies (High Priority)

Rationale: 38% concerned about academic integrity; Need for institutional guidance

Recommendations:

- **Policy Framework:**
  - Define acceptable vs. unacceptable AI use by assignment type
  - Require disclosure of AI assistance in assignments
  - Differentiate between AI as tool (allowed) vs. AI as author (prohibited)
- **Professor Guidelines:**
  - Sample syllabi language on AI use
  - Assignment design strategies that encourage ethical AI use
  - Detection strategies and response protocols
- **Student Resources:**
  - FAQ on AI usage policies
  - Examples of appropriate use by discipline
  - Self-assessment checklist for assignments

Success Metrics:

- 100% of syllabi include AI usage policy
- Academic integrity violations decrease by 20%
- Student confidence in appropriate use increases

3. Create AI Support Infrastructure (Medium Priority)

Rationale: 45% of Pragmatic Adopters need reliability improvements; Support needed for effective use

Recommendations:

- **AI Help Desk:**
  - Office hours for AI tool assistance
  - Online FAQ and troubleshooting guides
  - Peer tutor program (trained Power Users)
- **Institutional Licenses:**
  - Negotiate campus-wide licenses for premium tools

    - Provide free access to Copilot, ChatGPT Plus, Grammarly Premium
    - Address cost barrier (28% of students)
- **Resource Library:**
    - Curated prompt libraries by discipline
    - Best practice guides
    - Case studies of successful AI use

Success Metrics:

- 70% of students aware of AI resources
- Support requests handled within 24 hours
- Premium tool usage increases by 40%

Recommendations for AI Tool Developers:

1. For ChatGPT (OpenAI):

Strengths: Market leader, positioned in "ideal zone," high ease and features perception

Recommendations:

- **Maintain Leadership:** Continue focus on ease while adding capabilities
- **Education Features:** Develop "Education Mode" with:
    - Pedagogical responses (explain why, not just answer)
    - Source citations for all information
    - Academic integrity safeguards
- **Institutional Integration:** Partner with universities for licensed access

2. For GitHub Copilot:

Strengths: Highest feature perception, valued by Power Users

Opportunities: Lower ease perception limits adoption

Recommendations:

- **Improve Onboarding:** Interactive tutorial for first-time users
- **Educational Pricing:** Free for students (already doing, promote more)
- **Explain Mode:** Add comments explaining generated code
- **Non-CS Applications:** Expand beyond coding (data analysis, LaTeX writing)

3. For Google Gemini:

Challenge: Perceived as ChatGPT alternative without clear differentiation

Recommendations:

- **Unique Value Proposition:** Emphasize Google ecosystem integration
- **Academic Features:** Leverage Google Scholar, Docs integration
- **Multi-modal Strength:** Highlight image understanding for diagrams, charts
- **Research Focus:** Position as research assistant vs. general chatbot

4. For Claude (Anthropic):

Strengths: Emerging as preferred for analysis and writing

Recommendations:

- **Reliability Messaging:** Emphasize accuracy and trustworthiness

- **Academic Positioning:** Target as "thinking partner" for complex tasks
- **Long Context:** Leverage ability to handle long documents
- **Student Program:** Free tier or educational discounts

5. Market Gap Opportunity:

Unmet Need: Privacy-focused, education-specific AI tools

Recommendation for New Entrants:

- Develop AI tools specifically for education
- Features:
  - Privacy by design (data not used for training)
  - Curriculum-aligned capabilities
  - Institution certification and control
  - Pedagogy-first (facilitate learning, not just answers)
- Target: Cautious Users and institutional buyers
- Positioning: "Trusted AI for Education"

Recommendations for Students:

1. For Non-Adopters: Getting Started

- Start with one tool: ChatGPT (free, easiest)
- Begin with low-stakes tasks: Concept explanation, idea brainstorming
- Use alongside traditional methods, not as replacement
- Attend workshops to build confidence
- Resources: Institutional help desk, peer tutors

2. For Cautious Users: Building Confidence

- Always verify AI outputs with authoritative sources
- Use AI for initial research, not final answers
- Understand privacy settings and data usage
- Follow institutional policies on disclosure
- Gradually expand use cases as comfort grows

3. For Pragmatic Adopters: Optimizing Usage

- Learn prompt engineering techniques for better results
- Explore specialist tools for specific tasks (Copilot for code, Grammarly for writing)
- Join study groups to share effective prompts and strategies
- Experiment with advanced features (GPT-4, custom instructions)
- Balance AI use with deep learning for critical topics

4. For Power Users: Responsible Innovation

- Be aware of over-reliance risks
- Maintain verification habits even with high confidence
- Serve as peer mentors for less experienced users
- Experiment with new tools but evaluate critically
- Stay informed on AI developments and ethical considerations

5. Universal Best Practices:

- **Critical Thinking:** Always question AI outputs, don't accept blindly

- **Citation:** Disclose AI use when required by assignment
- **Privacy:** Don't input sensitive or personal information
- **Learning Focus:** Use AI to enhance understanding, not bypass learning
- **Iteration:** Refine prompts based on responses, engage in dialogue

Implementation Roadmap:

Phase 1: Foundation (Months 1-3)

- Develop AI usage policy
- Create freshman orientation module
- Establish AI help desk
- Launch institutional licenses

Phase 2: Expansion (Months 4-6)

- Roll out discipline-specific workshops
- Train peer tutors
- Build resource library
- Launch advanced certification

Phase 3: Optimization (Months 7-12)

- Collect usage data and feedback
- Refine policies based on learnings
- Expand successful programs
- Assess impact on learning outcomes

Phase 4: Evaluation (Month 12+)

- Conduct follow-up survey
- Measure impact on adoption, comfort, and outcomes
- Identify gaps and adjust strategy
- Plan for continuous improvement

Success Metrics by Stakeholder:

Institutional:

- AI literacy: 80% of students complete training
- Policy awareness: 90% of students familiar with policies
- Support satisfaction: 4.5/5 rating for AI resources
- Academic integrity: No increase in violations

Student:

- Adoption: 90% of students use AI tools (up from 78%)
- Comfort: Average technical comfort 7/10 (up from 5.5/10)
- Outcomes: 75% report improved learning efficiency
- Confidence: 80% confident in ethical AI use

Tool Developers:

- User growth: 25% increase in student user base
- Engagement: 40% increase in daily active users
- Satisfaction: Net Promoter Score > 50
- Differentiation: Unique value proposition recognized by 60% of users

Deliverable: Strategic recommendations document with implementation roadmap, success metrics, and stakeholder-specific action plans

Estimated Time: 1 week

Conclusion

This comprehensive marketing analytics project provides a robust methodology for understanding AI tool adoption, usage patterns, and preferences among students. By integrating qualitative research, quantitative surveys, and three advanced analytical techniques (Clustering, Discriminant Analysis, Perceptual Mapping), the approach delivers:

Key Contributions:

1. **Segmentation:** Identification of 4 distinct student segments with unique needs and barriers
2. **Prediction:** Classification model predicting segment membership with 82% accuracy
3. **Positioning:** Competitive landscape mapping of AI tools from student perspective
4. **Strategy:** Actionable recommendations for institutions, developers, and students

Broader Applications:
This methodology can be adapted to:

- Other educational technologies (LMS, collaboration tools, assessment platforms)
- Different contexts (corporate training, professional development)
- Various populations (faculty, staff, lifelong learners)

Future Research:

- Longitudinal studies tracking adoption over time
- Learning outcome measurement (grades, skill development)
- Cross-institutional comparisons
- Faculty perspectives and policies

By following this guide, researchers and practitioners can conduct rigorous marketing analytics projects that generate meaningful insights and drive positive change in educational technology adoption.

References & Resources

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Project Timeline Summary:

- **Phase 1:** 4-6 weeks (Qualitative research and problem definition)
- **Phase 2:** 3-4 weeks (Survey design, distribution, data collection)
- **Phase 3:** 3 weeks (Clustering, discriminant, perceptual analyses)
- **Phase 4:** 2-3 weeks (Visualization, insights, recommendations)
- **Total:** 12-16 weeks for complete project

Contact for Questions:

[Your Name/Team]
[Institution]
[Email]

This guide was developed as part of a marketing analytics research project at BITS Pilani. For the interactive prototype and supplementary materials, visit [URL].