# **🚲 Mod 4 Project — *Riding the Demand: Insights for a Bike-Share PM***

## **Context & Ownership**

You’re a data analyst on the BikeShare Product team. Your job is to extract **stakeholder-ready insights** from hourly usage data to inform **pricing, promos, staffing, and availability**.

**You are responsible for:**

* Exploring **all features** in the data (data is linked on Canvas)
* Consulting the **official online data dictionary** for definitions and coding ([UCI Bike Sharing dataset page](https://archive.ics.uci.edu/dataset/275/bike+sharing+dataset)). **Pay special attention to variables that may already be normalized (e.g., 0–1) know how to interpret normalized variables.**
* Producing stakeholder-relevant visuals and statistically sound conclusions.

**Individual project • Timebox:** ~4 days  
 **Allowed tools:** Python (You can use Plotly, Tableau, or Seaborn for visuals)

## **Stakeholders (and what they care about)**

* **Product Manager (PM):** When/where demand is strong or fragile; user behavior patterns; which hypotheses to prioritize next quarter.
* **Operations Lead:** Inventory rebalancing windows; staffing for spikes; low-impact maintenance windows.
* **Marketing Lead:** Promo timing (day/hour/season), and segments likely to respond (e.g., casual rider vs registered).
* **Policy & Ethics Advisor:** Equity of access; avoiding decisions that disadvantage specific times/areas; responsible communication of uncertainty.

Use these needs to frame your analysis, visuals, and recommendations.

## **KSB Alignment**

* **K4:** Distributions & their applications
* **K5:** Descriptive statistics (mean, median, SD, IQR)
* **K6:** Hypothesis testing (z-test, t-test, ANOVA, A/B)
* **S13:** Apply appropriate statistical techniques to understand relationships
* **B6:** Pursue deeper insights beyond surface observations
* **B9:** Challenge assumptions when developing solutions
* **B12:** Maintain ethical standards under pressure
* **K4 (biz impact), K9, K10, S6:** Map insights to business performance, product value, and user behavior; align to org objectives & stakeholder needs
* **B4, B8, B10:** Persistence in uncovering insights; genuine interest in user patterns and customer needs

## **What to Deliver**

### **1) GitHub Repository**

Include:

* README.md with:  
  + **Business framing** and stakeholders
  + Methods summary (EDA, tests, A/B design)
  + **Top 3 trends/insights** and why they matter
  + Results from hypothesis tests with **p-values, confidence intervals, decisions**, and **practical significance**
  + **Ethics & limitations** (assumptions, observational data)
* Analysis (notebooks or scripts) and **exported visuals as images**
  + If you use Tableau: include image exports of key sheets/dashboards and a link to your Tableau Public

### **2) Slide Deck (5–8 slides)**

1. **BLUF (Bottom Line Up Front):** your single most important takeaway in ~60 seconds
2. Data overview / EDA highlights (brief)  
   **Answers to stakeholder questions** with supporting EDA/visuals
3. **Hypothesis testing** results (which test you chose for each question, α and why, p-value, CI, decision)
4. **A/B (Part C) result:** clearly state **statistical** and **practical** significance
5. **Top 3 trends/insights** and next steps from your project as a whole (be sure to mention any risks/ethical considerations)

## **Project Tasks & Requirements**

### **Part A — Python EDA & Trends**

* Summarize data (statistical and descriptive summaries – don’t forget groupbys!)
* Create **at least 5 visuals** that directly address stakeholder needs (you choose the most appropriate plots; label clearly).
* Describe your **top 3 trends/insights** and explain why they matter to PM/Ops/Marketing.

### **Part B — Hypothesis Testing**

For each question below be sure to:

* **Choose the appropriate hypothesis test** (e.g., Welch’s t-test, one-way ANOVA, etc.) based on EDA and assumptions.
* State **H0/H1**, **choose α (Type 1 Error Threshold) and justify** (risk tolerance, decision cost).
* Report **test statistic, p-value, CI (you choose confidence level)**, and **decision**.
* Discuss **practical significance** (not just statistical) and any limitations.

**Q1 — Commuter pattern**Do average hourly rides **differ** between **working days** and **non-working days**?

**Q2 — Multi-group comparison**Do mean hourly rides **differ across categories** of multi-level categorical variables such as **season** or **weather condition (choose one)**? If you find a difference, describe the appropriate post-hoc (after the test what other tests would you do) approach and what it would tell stakeholders.

### **Part C — Simulated A/B Test (SPECIFIED)**

**Follow this exact setup.** The core analysis must match what’s below.

**PM Objective (fixed)**Increase commuter-hour ridership on **working days** during **early evening** after the launch of a small change of an app feature (this feature isn’t explicit because it is not necessary to know the details for this analysis).

**Primary Metric (fixed)  
Average hourly rides (cnt) during 17:00–19:00 on working days when weather is good.**

**Eligibility (fixed)** — keep a row only if **all** are true:

* workingday == 1
* hr ∈ {17, 18, 19}
* weathersit ∈ {1, 2} **and** hum ≤ 0.70

**Windows (fixed)** — pretend launch is **2012-09-01**

* **Pre (Baseline):** 2012-08-04 → 2012-08-31 (inclusive)
* **Post (Feature On):** 2012-09-01 → 2012-09-28 (inclusive)

**Build two groups (independent samples)**

* **Group A (Pre):** all **eligible** rows in the Pre window
* **Group B (Post):** all **eligible** rows in the Post window

**Make the comparison fair (simple stratified balance)**

* For each **time slot** (weekday × hour), count how many eligible rows you have in **Pre** and **Post**.
* For that slot, **keep the same number of rows in each group** by truncating both to the **smaller** count (random selection if needed, with a fixed seed).
* Stack the retained rows for all slots into **Group A** and **Group B**.
* Show a tiny balance table (counts per weekday × hour, and weather mix) to confirm the groups look comparable.

**Statistical test (required)**

* **Use the appropriate hypothesis test to** compare if there is a difference in the average total bike count (cnt) between **Group A (Pre)** and **Group B (Post)**.  
  + State the null and alternative hypotheses
  + **α = 0.05** (default; you may choose a different α if you justify the product risk).
  + Report: **test statistic, p-value, 95% CI for**, and **decision**.
* **Practical significance (required):** define a threshold you consider meaningful (e.g., **+5 rides/hour**). Conclude on **both** statistical and practical significance.

**Guardrail Metrics** Within the same filtered windows and groups, report:

* **Potential guardrail metrics you would consider**

Briefly note if shifts here would change your recommendation (equity, long-term value).

## **Rubric (100 pts)**

**A. EDA & Trends (25 pts)** — *K4, K5, S13, B6/B4/B8/B10*

* Five stakeholder-relevant visuals (10)
* Clear **top 3 trends/insights** with business relevance (10)
* Normalized-variable interpretation & data-quality checks, statistical summary, etc. (5)

**B. Hypothesis Testing (30 pts)** — *K6, B9, B12*

* Correct choice & justification of tests for Q1 & Q2 (10)
* Proper reporting (α rationale, p-values, CIs, decision) (12)
* Interpretation of **practical** significance + limits/assumptions (8)

**C. A/B Test (25 pts)** — *S13, K6, K9, K10, K4/K5, B6/B9/B12*

* Correct eligibility, windows, pairing and **correct statistical test** (10)
* α rationale, p-value, 95% CI, decision; **practical threshold** check (10)
* Balance check + guardrails + succinct PM recommendation (5)

**D. Communication (10 pts)** — *S6, K4/K9/K10*

* 5–8 slide deck with **BLUF**, crisp visuals, stakeholder-oriented takeaways (10)

**E. Professionalism (10 pts)** — *B12*

* Organized repo, reproducibility notes, ethical caveats (10)

## **Suggested Timeline (~3.5 days)**

* **Day 1:** Frame stakeholder questions; EDA; consult data dictionary; draft visuals.
* **Day 2:** Complete EDA; finish **Q1** and **Q2** hypothesis tests.
* **Day 3:** Execute **Part C** A/B analysis; draft slides.
* **Day 4:** Polish slides/README; finalize recommendations

## **Questions to Consider when crafting your slide deck and README**

* Why is your chosen **α** appropriate given the cost of false alarms vs missed opportunities?
* If a result is statistically significant but **below your practical threshold**, what do you recommend and why?
* Which **assumptions** would most threaten your conclusion, and how would you test them in a future **true randomized** pilot?
* How could this analysis inadvertently disadvantage certain bike riders or times, and how would you mitigate that?