7COM1079-0901-2024 - Team Research and Development Project

Final report title: How does the average length of hospital stay differ between patients admitted for an acute care and childbirth care?

Group ID: A283

Dataset number: DS239 (length\_of\_hospital\_stay.csv)

Prepared by: Ankit Joshi 22032491

Piyush Kumar Mallick 23079409

Ahmad Mujtaba Khan 2311130

Haider Abid 23081929

Jeswanth Kumar Botcha

University of Hertfordshire

Hatfield, 2024

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1. Introduction

* 1. Problem statement and research motivation **(100 words)**

We want to learn more about the reasons behind the variation of hospital stays of which following could be some of the reasons.

* **Rise in healthcare costs**: Healthcare prices have grown dramatically during the last several decades. Hospital stays account for a large portion of these expenses, thus it is vital to study changes in typical stay durations and the reasons driving them.
* **Advancement in healthcare**: Advances in medical technology, outpatient treatment, and clinical standards may have resulted in shorter hospital stays. (Shah, 2024)
* **Efficiency of hospitals**: Shorter hospital stays are sometimes viewed as a sign of healthcare efficiency, but they might jeopardize quality of treatment if not handled effectively.
  1. The data set **(75 words)**

The data set provided to us contains the length of hospital stays for acute disease and childbirth for various nations across the globe for past few decades.The dataset contains columns of interest which are “subject” which will be our independent variable of nominal type. The other column will be “value" which is our dependent variable of ordinal type.

The data set is intriguing to work on, as it would be great to know the factors that might be responsible for the variation of hospital stays over the years which could be technological advancements, rise in healthcare cost or other factors.

* 1. Research question **(50 words).**

Our research question is “How does the average length of hospital stay differ between patients admitted for an acute care and childbirth care?”

We will be doing a comparison of means analysis to answer our RQ, if there is a difference of hospital length stays between acute disease and childbirth.

* 1. Null hypothesis and alternative hypothesis (H0/H1) **(100 words)**

Below is our hypothesis:

* Null hypothesis (H0): There is no difference in the mean of the hospital stay between acute care and childbirth care.
* Alt hypothesis (H1): There is a difference in the mean of the hospital stay between acute care and childbirth care.

1. Background research
   1. Research papers (at least 3 relevant to your topic / DS) **(200 words)**

Upon searching for the dataset being used for research papers, I didn’t find the exact dataset but did find some research papers along this topic of length of hospital stays, mentioning few of them below:

* **Statistical analysis on length of stay in hospital**

The rising financial problems of healthcare institutions make studies of resource distribution more and more important and valuable. Among these studies, identification of length of stay of hospital patients (LOS) has attracted many scientists recently since it contributes to better knowledge of hospital costs and helps these institutions control the costs. This paper is devoted to study the length of stay of inpatients in hospital. Although predicting the length of stay is difficult, it is actually useful and beneficial if some key factors that have influence on patient length of stay could be determined. (Nguyen and Dang, 2021)

* **Evaluation of factors that influenced the length of hospital stay using data mining techniques**

In hospitals, there are major performance indicators, including LOS, bed occupancy rate, bed turnover, bed turnover interval, and mortality rates that should be determined and monitored regularly [[15](https://bmcmedinformdecismak.biomedcentral.com/articles/10.1186/s12911-022-02027-w#ref-CR15)]. This study aimed to evaluate each inpatient’s LOS and its associated factors in six different wards of the hospital using statistical analysis along with data mining by the R-studio program. The average LOS in the study population was about two days. Results also demonstrated that about 60% of patients were discharged after one night of hospitalization. (skandari, M., Alizadeh Bahmani, A.H., Mardani-Fard, 2022)

* **Predicting hospital length of stay using machine learning on a large open health dataset**

The study showcases the practical utility of machine learning models in predicting LoS during patient admittance. The emphasis on interpretability ensures that the models can be easily comprehended and replicated by other researchers. Healthcare stakeholders, including providers, administrators, and patients, stand to beneﬁt signiﬁcantly. The ﬁndings oﬀer valuable insights for cost estimation and capacity planning, contributing to the overall

enhancement of healthcare management and delivery. (Jain, Singh, Rao and Garg, 2024)

* 1. Why RQ is of interest (research gap and future directions according to the literature) **(100 word**s)

Understanding trends in the average length of hospital stays for acute diseases and births is relevant to healthcare planning, resource allocation, and patient outcomes. Existing study frequently focuses on overall hospital efficiency or specific circumstances, but it lacks a full historical examination of these critical areas. Exploring this gap reveals information on how advances in medical treatment, regulatory changes, and socioeconomic variables have affected hospital stays. This research also informs future healthcare initiatives, such as increasing patient flow and adapting treatment to changing requirements, while also considering the possible effect of technological and healthcare delivery advancements.

1. Visualisation
   1. Appropriate plot for the RQ(**50 words)**

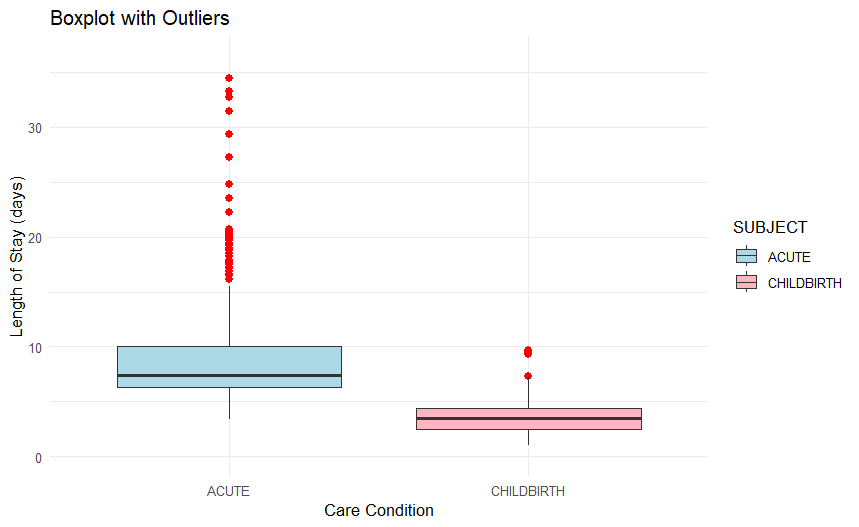


Figure Boxplot with outliers

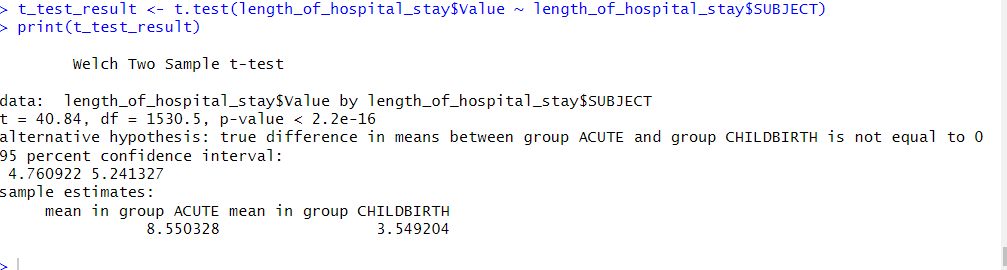
We chose to plot a boxplot with outlier for our visualisation because they are very useful for immediately determining the location, dispersion, and symmetry or skewness of a collection of data, as well as comparing these qualities across two or more data sets.

* 1. Useful information for the data understanding (**50 words)**

The plot illustrates that the acute care condition has a longer median duration of stay and greater variability than delivery, with more severe outliers. Childbirth requires a shorter and more regular duration of stay. Outliers are common in acute care, suggesting variations in patient conditions or treatment durations.

1. Analysis
   1. Statistical test used to test the hypotheses and output (**75 words)**

Our independent variable was of type nominal and dependent variable was of type ordinal, our dependent variable was normally distributed and our independent variable had exactly two values. Taking all the above conditions into consideration we chose to go with t.test to test our hypothesis.



* 1. The null hypothesis is rejected /not rejected based on the p-value (**100 words)**

The null hypothesis is rejected based on the stated p-value in the t-test (p<2.2×10−16). The null hypothesis states that there is no difference in the average length of hospital stay between the acute and childbirth groups. The tiny p-value (𝛼 = 0.05, α = 0.05) suggests a significant difference in mean hospital stay between the two groups. Therefore, the alternative hypothesis is supported.

1. Evaluation – group’s experience at 7COM1079
   1. What went well **(75 words)**

The group displayed excellent teamwork and communication skills, ensuring that responsibilities were assigned equally and deadlines were reached. The application of theoretical knowledge to actual settings was a standout feature, demonstrating comprehension of fundamental ideas. Members assisted each other in overcoming problems, demonstrating strong peer support. The incorporation of varied ideas enhanced the project, and frequent meetings kept the team on track. The final output fulfilled quality standards by demonstrating substantial research and well-executed execution techniques.

* 1. Points for improvement **(75 words)**

The group might benefit from more defined work assignments to reduce overlap and delays. Time management in the early stages should have been improved, since the team occasionally misjudged the difficulty of assignments. Clearer recording of choices made during meetings would help increase openness. Furthermore, making better use of project management technologies might aid in progress tracking and accountability. Finally, certain team members may benefit from improving their technical abilities so that they can contribute more effectively to specific elements of the project.

* 1. Group’s time management (**50 words)**

The group managed time adequately overall, completing key deliverables on schedule. However, the early stages lacked clear timelines, causing minor delays. Improvements in task prioritization and proactive planning helped mitigate these issues. Towards the end, time allocation was optimized, enabling the team to refine the final deliverable successfully.

* 1. Project’s overall judgement (**50 words)**

The project was a success, reflecting a solid understanding of the subject matter and effective teamwork. The deliverables met expectations, with the group demonstrating critical thinking and problem-solving skills. While some challenges arose, they were addressed efficiently, resulting in a high-quality output that aligns with the course’s objectives.

* 1. Comment on the GitHub log output **(50 words)**

The GitHub log output gave significant information on the group's workflow and collaboration. Frequent commitments indicated continuous progress and work sharing among team members. Clear commit messages increased clarity in modifications, facilitating traceability. However, several commits were huge and less informative, and might have been divided into smaller, more focused improvements.

1. **Commit Message:** [Boxplot with outlier] Boxplots containing outliers give a useful visual overview of data, including probable influence points, which aids in the first investigation and comparison of averages. However, they should be used in combination with other statistical techniques to provide a more robust and trustworthy comparison.
2. **Commit Message:** [T test code snippet] The t-test is a statistical hypothesis test used to determine if there's a significant difference between the means of two groups.
3. **Commit Message:** [R code] This contains all the R code scripts we used while working on the RQ including the plots and tests run.

1. Conclusions
   1. Results explained (**75 words)**

The t-test results indicate a significant difference in hospital stay length between acute care (mean = 8.55 days) and delivery (mean = 3.55 days), with a p-value < 2.2e-16. The 95% confidence range for the mean difference is [4.76, 5.24], indicating that lengthier hospital stays for acute treatment have statistical significance. This is consistent with the boxplot, which highlights acute care's larger mean and variability compared to delivery.

* 1. Interpretation of the results (**75 words)**

The study found that acute care patients have much longer hospital stays (mean = 8.55 days) than delivery patients (mean = 3.55 days). This emphasizes the complexity of acute care, which necessitates additional resources and longer treatment times. For the population, this translates into greater healthcare bills and resource demands. In a broader sense, it stresses the need of efficient acute care resource allocation, preventative initiatives to minimize acute care cases, and prospective legislative changes to better balance healthcare delivery and expenditures.

* 1. Reasons and/or implications for future work, limitations of your study (**50 words)**

The study's weaknesses include a limited sample size and potential data collecting biases, which may impair generalizability. To improve results, future research might increase the sample size, investigate new factors, and optimize methodology. Addressing these shortcomings will result in more complete insights and increase the study's usefulness.

1. Reference list

Dr. Julia G., Dr. Alveen S. (2024) Team Research and Development Project

Lecture handouts. University of Hertfordshire. 26 December, 2024.

Eskandari, M., Alizadeh Bahmani, A. H., Mardani-Fard, H. A., Karimzadeh, I., Omidifar, N. & Peymani, P., (2024) Evaluation of factors that influenced the length of hospital stay using data mining techniques. Available at: https://bmcmedinformdecismak.biomedcentral.com/articles/10.1186/s12911-022-02027-w [Accessed on 28 Dec, 2024]

Jain, R., Singh, M., Rao, R. & Garg, R., (2024). Predicting hospital length of stay using machine learning on a large open health dataset. *BMC Health Services Research*, 24. doi:10.1186/s12913-024-11238-y. Available at: https://www.researchgate.net/publication/382653655\_Predicting\_hospital\_length\_of\_stay\_using\_machine\_learning\_on\_a\_large\_open\_health\_dataset [Accessed on 29 Dec, 2024]

Nguyen, D., Ho Dang, P., Nguyen, T. & Nguyen, V., (2021) Statistical analysis on length of stay in hospital. *Science & Technology Development Journal - Engineering and Technology*, 3, first. doi:10.32508/stdjet.v3iSI3.651. Available at: https://www.researchgate.net/publication/348688920\_Statistical\_analysis\_on\_length\_of\_stay\_in\_hospital/citation/download [Accessed on 29 Dec, 2024]

1. Appendices
2. R code used for analysis and visualisation. Analysis.R code with the appropriate statistics to test the hypotheses.

#Box plot with outliers

ggplot(length\_of\_hospital\_stay, aes(x = SUBJECT, y = Value, fill = SUBJECT)) +

geom\_boxplot(outlier.color = "red", outlier.shape = 16, outlier.size = 2) +

theme\_minimal() +

labs(title = "Boxplot with Outliers ", x = "Care Condition", y = "length of stay(days)") +

scale\_fill\_manual(values = c("lightblue", "lightpink"))

#extended version of box plot

ggplot(length\_of\_hospital\_stay, aes(x = SUBJECT, y = Value, fill = SUBJECT)) +

geom\_boxplot(outlier.color = "red", outlier.shape = 16, outlier.size = 2) +

theme\_minimal() +

labs(title = "Boxplot with Outliers", x = "Care Condition", y = "Length of Stay (days)") +

scale\_fill\_manual(values = c("lightblue", "lightpink")) +

expand\_limits(y = c(0, max(length\_of\_hospital\_stay$Value) + 2) # Extend y-axis upwards

#Histogram with overlay curve

hist\_data <- hist(length\_of\_hospital\_stay$Value,

plot = FALSE) # Keep as frequencies (default behavior)

# Extend the y-axis by adding space above the tallest bar

y\_max <- max(hist\_data$counts) +40 # Adjust "+ 5" to add more space

# Plot the histogram with frequency counts

hist(length\_of\_hospital\_stay$Value,

main = "Histogram",

xlab = "Length of Stay",

col = "lightblue",

border = "black",

ylim = c(0, y\_max))

# Calculate mean and standard deviation

mean\_val <- mean(length\_of\_hospital\_stay$Value)

sd\_val <- sd(length\_of\_hospital\_stay$Value)

# Overlay the normal curve scaled to frequency

curve(dnorm(x, mean = mean\_val, sd = sd\_val) \* length(length\_of\_hospital\_stay$Value) \* diff(hist\_data$breaks)[1],

col = "red",

lwd = 2,

add = TRUE)

# t test

> t\_test\_result <- t.test(length\_of\_hospital\_stay$Value ~ length\_of\_hospital\_stay$SUBJECT)

> print(t\_test\_result)

1. GitHub log output.

commit 24d88eaf67933d85955eca5e5bfaff026db52030 (HEAD -> main, origin/main, origin/HEAD)

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Tue Jan 7 16:10:43 2025 +0530

Final Report

commit 9a96095165e066d59b904b17a38b8c83be4a6edc

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Tue Jan 7 16:10:18 2025 +0530

Delete 7COM1079\_Final report\_2.12.24-2.docx

commit 0b5b6124ff677f65015cbb1fac6c0220ac83f44b

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Tue Jan 7 15:52:47 2025 +0530

Delete 7COM1079\_Final report\_2.12.24-2Haider.docx

commit 6b3cdd02b83247350f15c5b664b5e7affa003206

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Tue Jan 7 15:52:36 2025 +0530

Delete 7COM1079\_Final report\_2.12.24-2Haider2.docx

commit b60670e290a233b84de686b3cb06a947dd42b8da

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Tue Jan 7 15:52:25 2025 +0530

Delete 7COM1079\_Final report\_2.12.24-2Haider3.docx

commit 9ed8f8ac6eb7e34107a0eab062aee53ec45ce53b

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Tue Jan 7 15:51:02 2025 +0530

Final report apart from github log

commit d4978f2dfb5692c7aa9b6aac6a64efa78e8a93f1

Author: Haider Abid <ha24abb@herts.ac.uk>

Date: Mon Jan 6 18:51:41 2025 +0000

My third commit of final report

commit 962ab29af3bf3643112fc0a5600b0f707a758eab

Author: Haider Abid <ha24abb@herts.ac.uk>

Date: Mon Jan 6 18:51:01 2025 +0000

My second commit of final report

commit 3f9519164a9745a27e1765f3b7183c3ae291ffb8

Author: Haider Abid <ha24abb@herts.ac.uk>

Date: Mon Jan 6 18:47:46 2025 +0000

My first commit

commit 843dcf9d46724374e1fed1b4133d6403e72f3a7a

Author: Piyush Kumar Mallick <pm24abn@herts.ac.uk>

Date: Sun Jan 5 19:40:34 2025 +0000

roughly wrote a few points .

commit 17c224c07816082f37e1f76643c4cff0fe9ba6f0

Author: Piyush Kumar Mallick <pm24abn@herts.ac.uk>

Date: Sun Jan 5 18:12:10 2025 +0000

jaswant's name has been added

commit 6106f7f473297bf82964846a59c72dd798bb4e79

Author: Piyush Kumar Mallick <pm24abn@herts.ac.uk>

Date: Sat Jan 4 19:25:10 2025 +0000

final report formatted

commit 42e63a56626e3a0085ccdaa282384f6211939e16

Author: Piyush Kumar Mallick <pm24abn@herts.ac.uk>

Date: Sat Jan 4 17:00:47 2025 +0000

1st section complete final report

commit b97f6d01a660dc7750ce24a0dfba739b46d5e9a1

Author: Piyush Kumar Mallick <pm24abn@herts.ac.uk>

Date: Wed Dec 25 03:03:32 2024 +0000

final report fourth commit

commit 252294fb287b27f52f597c19b5da7e24da287cef

Author: Piyush Kumar Mallick <pm24abn@herts.ac.uk>

Date: Wed Dec 25 02:51:12 2024 +0000

final report third commit

commit 11d7f33f6ff619ae801162fa1ce9256c44580b12

Author: Piyush Kumar Mallick <pm24abn@herts.ac.uk>

Date: Tue Dec 24 18:07:59 2024 +0000

g

commit 8abb3754a264e2a168a2ec701805cdfc72effd11

Author: PiyushUniHerts <pm24abn@herts.ac.uk>

Date: Tue Dec 24 15:32:52 2024 +0000

Add files via upload

commit a1b75994a5abd56f672a8a185c13e4e6c206f404

Author: AhmadMujtabaKhan1 <ak24afv@herts.ac.uk>

Date: Sun Nov 24 19:12:19 2024 +0000

Delete A283 RQ .pptx

commit bfc8f27aba103592896e386d66b218fa84d68861

Author: AhmadMujtabaKhan1 <ak24afv@herts.ac.uk>

Date: Sun Nov 24 19:10:17 2024 +0000

Final ppt of RQ

commit 2a388a1fd87168286bb35a0ede65ee93783e5587

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Mon Nov 25 00:34:33 2024 +0530

Box plot with outlier

commit 638f912844f49027f1d2ca375ffbea829bfab375

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Mon Nov 25 00:34:04 2024 +0530

Delete Boxplot with outlier.png

commit 5a9e97a2f854d3a197709a4f00701086147b0cfb

Author: AhmadMujtabaKhan1 <ak24afv@herts.ac.uk>

Date: Sun Nov 24 18:37:11 2024 +0000

RQ final ppt

commit c0a47494934e230afae8cdd19b08b944351549fd

Merge: b09e53b bacbf63

Author: PiyushUniHerts <pm24abn@herts.ac.uk>

Date: Sun Nov 24 18:20:18 2024 +0000

Merge branch 'main' of https://github.com/PiyushUniHerts/Team-Research-Repo-A283

commit b09e53b1d197620bc2859e29296ec973bf19df55

Author: PiyushUniHerts <pm24abn@herts.ac.uk>

Date: Sun Nov 24 18:20:07 2024 +0000

final code

commit bacbf63f5c4ed9d2fc319daaa84c6c8c5c691ec0

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Sun Nov 24 23:44:13 2024 +0530

Rcodes.doc

commit b15f34d79819fbd1a58a57eff2c5b1d17a038fd0

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Fri Nov 22 17:44:49 2024 +0530

R code

commit c85469604ae53b9dd3e824cc64eff15a4f2d7a54

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Fri Nov 22 17:44:27 2024 +0530

T test code snippet

commit 943cd255a19b144015986fc0771ad6fbc980c836

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Fri Nov 22 17:44:04 2024 +0530

Histogram with curve

commit 41cffcdaaa2d77faf131914e24020f3d8c0e54bc

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Fri Nov 22 17:43:45 2024 +0530

Histogram

commit 6ad0ee300f6fc3a03187b8656301c4a8accdd915

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Fri Nov 22 17:41:05 2024 +0530

Boxplot with outlier

commit 6e800db71a8e97825a4049c45bedca08759bf794

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Fri Nov 22 06:20:15 2024 +0530

Histogram with curve

commit b8a1ad0449bc54427d11520baa91c4c14990fe66

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Fri Nov 22 06:19:58 2024 +0530

histogram

commit 7b1e5b475fe369899329381e65ee979577237473

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Fri Nov 22 06:19:40 2024 +0530

Boxplot with outlier

commit 7b39cfc1348b6d8bbf552fb2110ba068728539c6

Author: PiyushUniHerts <pm24abn@herts.ac.uk>

Date: Thu Nov 21 18:07:04 2024 +0000

first r file commit

commit 61289525da69730e52e049ff269a260b3542c9b8

Author: PiyushUniHerts <pm24abn@herts.ac.uk>

Date: Thu Nov 21 18:05:12 2024 +0000

first commit r file

commit e51934f598e672e5e04c1951745cca14eb6b40a7

Author: PiyushUniHerts <pm24abn@herts.ac.uk>

Date: Thu Nov 21 02:04:19 2024 +0000

Add files via upload

commit cfb43d373e34a6b84359d58c3a2099c09ba3c73c

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Thu Nov 21 05:01:54 2024 +0530

RQ ppt

commit 1053e838c966ff26950965a4964e2900796abcc4

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Thu Nov 21 05:01:17 2024 +0530

Delete reseach\_question\_presentation\_template (2).pptx

commit ac561cef921cc3d1a623ffbb8e2655d8ede5ca51

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Thu Nov 21 05:01:09 2024 +0530

Delete reseach\_question\_presentation\_template (1).pptx

commit f403a6e312d51e4ddfa18f27429448a72cc8f880

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Thu Nov 21 05:00:58 2024 +0530

Delete latest.pptx

commit 271bcb653bd9b20e5dd4db1efe2648ee61d2a50b

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Thu Nov 21 04:39:22 2024 +0530

latest ppt RQ

commit 973ce8a268b4bd8d2c5cba0b5612eb233b0bb19f

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Wed Nov 20 17:36:35 2024 +0530

commit new research question

commit 73712c7dfe2912face9fe75df2794205c9dcdc76

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Tue Nov 19 04:42:39 2024 +0530

ppt\_research\_question

commit d0d85a5d7f32eb103b5e1aebca41572cb8796a7b

Author: Ankitjoshi171997 <aj23aej@herts.ac.uk>

Date: Tue Nov 19 04:41:46 2024 +0530

Add files via upload

Dataset

commit 3e56aa3d5db7fe14c0939e11171fc7c80c63291f

Author: PiyushUniHerts <pm24abn@herts.ac.uk>

Date: Mon Nov 18 22:13:18 2024 +0000

Initial commit