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Individual Assignment Cover Sheet

Course Code:	RSM8431 Analytics Colloquia	Date:	2026/1/16
Course Title:	Process Mining	**Student Number:**	1011886924
Instructor Name:	Arik Senderovich		
Assignment Title:	MMA_Project_2026		

Academic Integrity Compliance

In submitting this assignment, I affirm the work represents entirely my own efforts. I accept and understand the consequences of violating the University of Toronto's Academic Integrity policies as outlined in the

Code of Behaviour on Academic Matters.

I confirm that:

- I have followed the instructions for the assignment, including any specific formatting requirements.
- My work is original. Due credit is given where appropriate and I have acknowledged the ideas, research, phrases etc. of others with accurate and proper citations.
- I have kept my work to myself and did not share answers/content with others, unless otherwise directed by my instructor.
- Any proofreading by another was limited to indicating areas of concern which I then corrected myself.
- This is the first time I have submitted this assignment (in whole or in part) for credit.
- This is the final version of my assignment and not a draft.
- I am submitting this work for the correct course, via the specified platform/method (e.g. Quercus).

I agree that the statements above are true. If I have concerns, I will consult the course instructor immediately.

Optional: you may wish to follow the standard naming convention when saving files:

Complete Course Code (including Section) – STUDENT NUMBER – **Assignment Title**

Example: **RSM1234HF.2021-0108**-0123456789-**Homework1**

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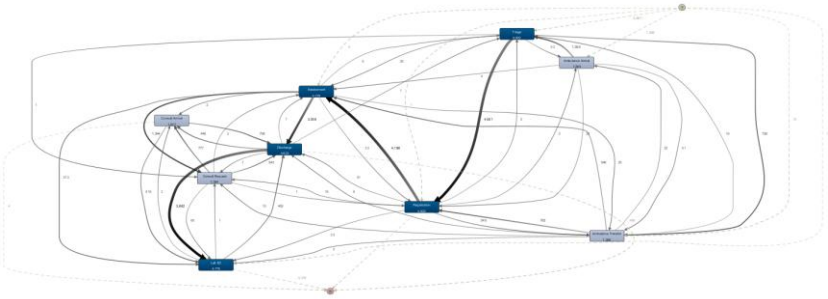
Part 1: Process Discovery and Analysis with DISCO

2.2 Tasks

2. Process Discovery

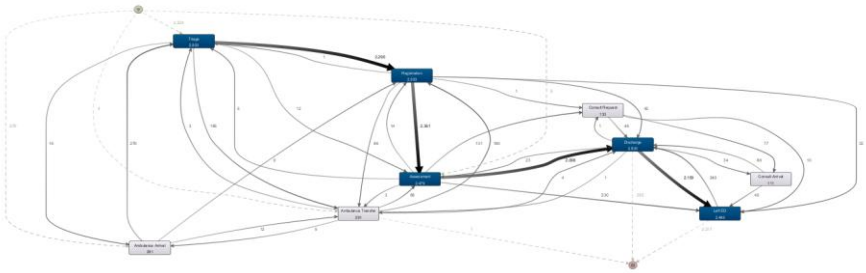
- **Identify the "Happy Path" for a CTAS Level 2 (EMERGENCY) patient.**

From the below process graph, the Happy Path is: Triage -> Registration -> Assessment -> Discharge -> Left ED. This covers 30% of all cases, and 32% of all events. The median duration of the path is: 6m + 35 m + 2.5h + 13.5m = 3h24.5m



- **Use the Attribute Filter to isolate cases that spent time in the EPZ zone. How does the process graph change?**

The process graph now has fewer paths. Around 15% of all cases, and 14% of all events involve time spent in the EPZ zone. The Happy Path is still: Triage -> Registration -> Assessment -> Discharge -> Left ED. The median duration of the path is: 5m + 25 m + 68m + 6m = 1h44m



3. Performance Analysis

- **Calculate the median time between Registration and Assessment. This is the PIA (Physician's Initial Assessment) time**

Through filtering activities under trim longest mode: Start point = Registration, End point = Assessment, the median time is calculated as 34 min.

- **Identify the LWBS (Left Without Being Seen) rate: Analyze patients with disposition descriptions such as "Left After Triage" or "Left After Initial Assessment". What is the median time these patients spent in the ED before leaving?**

After filtering attributes:

(1) disposition_desc = "Left After Triage" or "Left After Initial Assessment"

And filtering activities under trim longest mode:

(2) Event start point = “Registration” or “Triage”

(3) Event end point = “Left ED”

The median time patients spent in the ED is 113.5 minutes.

- **Identify the ‘Ping-pong’ effect: How often do patients move back and forth between zones or repeat assessments?**

I checked all variants from the data set, but detected no cases where a certain activity was repeated over once. Therefore, there is no “Ping-pong” effect in the current data set. Because zone information is not given except for the initial zone when the patient first arrived, the analysis of patients moving back and forth between zones cannot be carried out.

- **Consultations: Filter for cases containing the Consult Request activity. What is the average delay added by waiting for a consultant to arrive?**

After filtering activities with ‘Consult Request’ under mandatory mode, the average delay added by waiting for a consultant to arrive (mean duration between consult request and consult arrival) is 2.3 hrs.

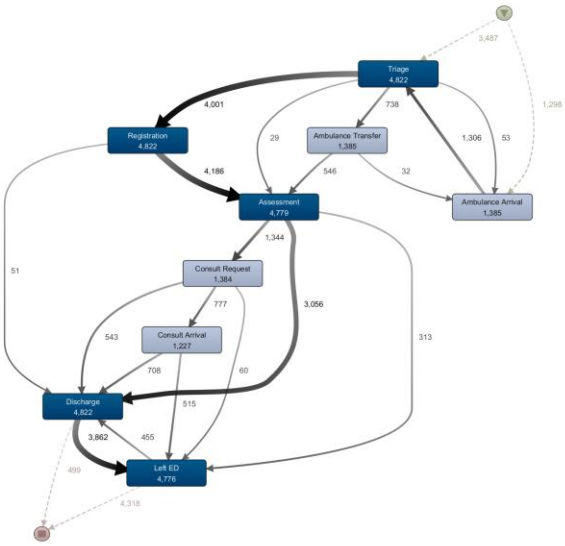
2.3 Deliverables

- **Annotated process maps for the main triage levels.**

For clarity, process maps are shown with activity slicer = 60%, path slicer = 40%.

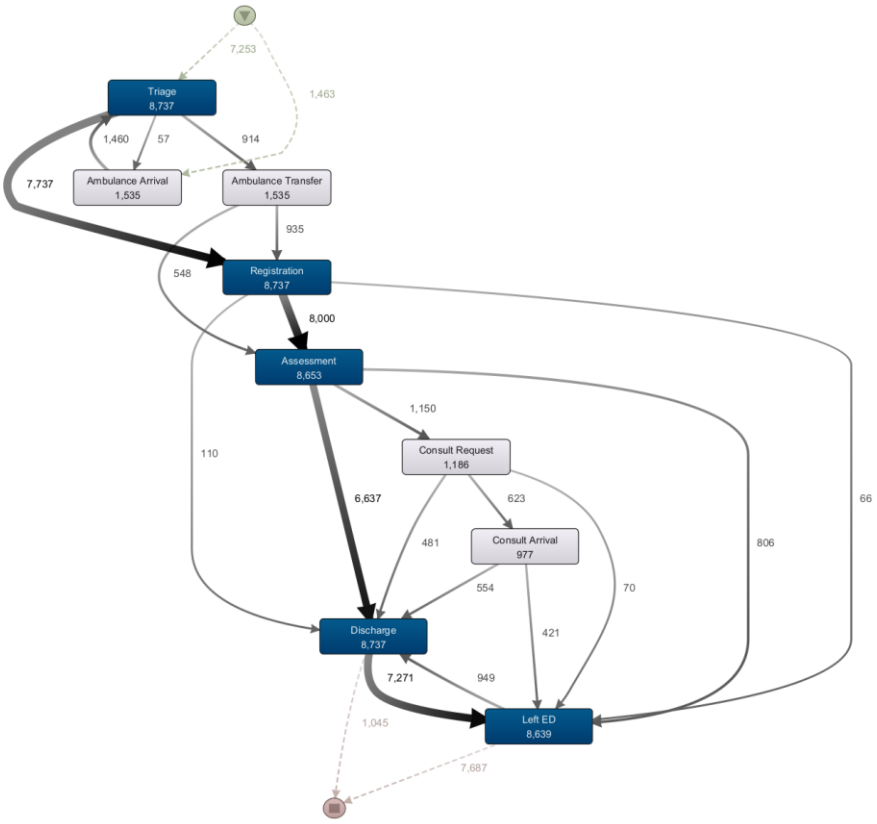
Triage Emergency (30% cases)

For this triage level, 54% of patients go through the happy path (Triage – Registration – Assessment – Discharge – Left ED). 22% arrive through ambulance, and 22% request consultancy.



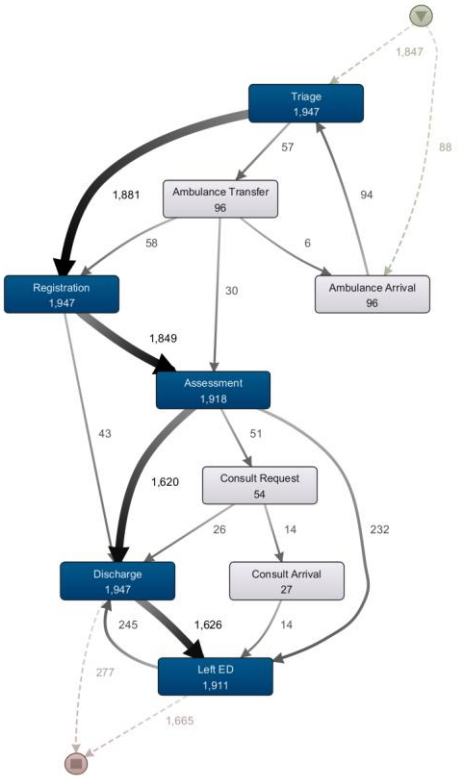
Triage Urgent (54% cases)

For this triage level, 73% of patients go through the happy path. 13% arrive through ambulance, and 8% request consultancy.



Triage Semi-urgent (12% cases)

For this triage level, around 90% of patients go through the happy path.



- **Top 3 bottlenecks found:**

Top 3 Bottleneck Stages	Median Duration
Assessment -> Consult Request	2.3 hrs
Consult Request -> Consult Arrival	117 mins
Assessment -> Discharge	92 mins

- **Strategic recommendations for the NTH COO based on your DISCO findings**

Based on the process discovery and performance analysis conducted using DISCO, several strategic opportunities emerge for improving patient flow, reducing delays, and enhancing operational efficiency in the Emergency Department (ED). The analysis indicates that while a clear and consistent “Happy Path” exists across all triage levels, significant delays arise at specific stages that materially extend patient length of stay and increase the risk of congestion and patient dissatisfaction.

The most critical area for intervention relates to consultation-related delays. The DISCO analysis identifies consultation processes as the largest bottlenecks in the ED, with a median duration of approximately 2.3 hours between assessment and consult request, followed by an additional median wait of 117 minutes before consultant arrival. These delays substantially prolong overall patient throughput and affect both emergency and urgent triage categories. To address this issue, the COO should prioritize the implementation of earlier and more structured consultation triggers, particularly for higher-acuity patients. Establishing standardized clinical criteria for early consult initiation and setting clear response-time expectations for consultants could significantly reduce waiting times and improve downstream flow without necessitating substantial increases in staffing.

In addition to consultation delays, the transition from assessment to discharge represents another key contributor to prolonged ED stays. Even for patients following the Happy Path, the median duration between assessment and discharge remains high at 92 minutes. This suggests opportunities to improve efficiency through enhanced discharge planning, streamlined documentation, and earlier initiation of discharge readiness checks during assessment. By reducing decision-making and administrative delays at this stage, the ED can increase patient turnover and alleviate pressure on assessment areas, particularly during peak demand periods.

The analysis further highlights the effectiveness of the Emergency Processing Zone (EPZ) as a fast-track pathway. Although only approximately 15 percent of cases involve time spent in the EPZ, these patients experience substantially shorter median ED durations compared to the overall population. This suggests that the EPZ is an effective mechanism for accelerating patient flow when appropriately utilized. The COO should consider expanding EPZ eligibility criteria for suitable CTAS Level 2 and 3 patients and reinforcing triage-level decision support to ensure consistent and optimal use of this resource.

Another important finding concerns patients who leave without being seen (LWBS). These patients spend a median of 113.5 minutes in the ED before leaving, typically during the early stages of their visit following triage or initial assessment. This indicates that early-stage delays are a key driver of LWBS risk. Targeted efforts to reduce the Registration-to-Assessment (PIA) time, improve communication around expected wait times, and implement periodic patient reassessments could help mitigate premature departures and reduce associated clinical and reputational risks.

Finally, the consistency of the Happy Path across triage levels presents an opportunity to standardize and reinforce best-practice workflows. A majority of patients, particularly in urgent and semi-urgent categories, follow this optimal sequence of care. By using the Happy Path as a benchmark process, the ED can more easily identify deviations, monitor performance, and guide staff training. Standardizing care delivery around this proven pathway would support greater reliability, reduce unnecessary variation, and improve overall operational predictability.

In summary, the DISCO findings suggest that targeted improvements in consultation workflows, assessment-to-discharge efficiency, EPZ utilization, and early-stage patient flow could materially enhance ED performance. These interventions focus on optimizing existing processes rather than structural expansion, making them both practical and cost-effective strategies for improving patient outcomes and operational resilience.

Part 2: Building an Intelligent Process Mining Tool

Please see code in GitHub repository:

> HzyBetty/project_process_mining: This project focuses on applying process mining and advanced analytics to analyze and improve patient flow in an Emergency Department (ED) setting, using real-world event log data.

And uploaded mp4 app demo for exact usage.

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Final Page

Grade: _____