Systemic Excess of Water: Floods
Part I: Initial Assessment

MFE 634
Quality and Productivity
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Team Members
Jake Jock
Jorge L. Romeu

Problem Statement

This project analyzes Subtropical Systemic Water Problems: floods & droughts. Jake Jock will analyze flooding, and Dr. Jorge L. Romeu will analyze droughts.

- Scope:
  - Analysis of a specific region with systemic (annual tropical & subtropical problems), such as diversion of flood waters to avoid damages to stakeholders: loss of life (human & animals), housing, property
  - More background can be found here:

  https://en.wikipedia.org/wiki/Tropics
  https://en.wikipedia.org/wiki/Subtropics#Definition

- Not in our scope of study?
  - Occasional problems (transient)
  - Political issues
  - Other regions

Project Topic

- This project aims to apply quality engineering techniques to mitigate drought and flood cycles in tropical savannahs (more information on regional climate here, https://en.wikipedia.org/wiki/Tropics and https://en.wikipedia.org/wiki/Subtropics#Definition).
- Tropical savannahs are common in areas such as Cuba, Gulf of Mexico, Central and South America, India, Indonesia, and several coastal countries in Africa. These region share similar annual seasons, rain and drought. During the rain season, copious amounts of rain inundate the countryside. During the drought season, limited rain burdens residents, cattle, and agriculture from lack of water.
- Input/output models show rain either is evacuated, or water levels rise, causing flooding in surrounding areas. The task is to find a way to evacuated the water at the same rate the rain falls on the ground. Several issues can prevent this. There may not be enough means (rivers, canals, etc.), areas with limited gradient, i.e. flatlands may not allow water to flow quickly enough to the sea, and wetlands close to the sea may cause water to accumulate and block flow into the sea. These issues may cause water levels to rise inundating surrounding areas.
- Furthermore, rainwater from the flood season must be stored for use in the drought season to avoid lack of water. To avoid this, lakes, reservoirs, distribution canals, etc. must be built to store rainwater during the flood season.
- Our project objective is a design and construction of a system that fulfills these discussed requirements. The first part is the flood season, this will be address in this assessment.

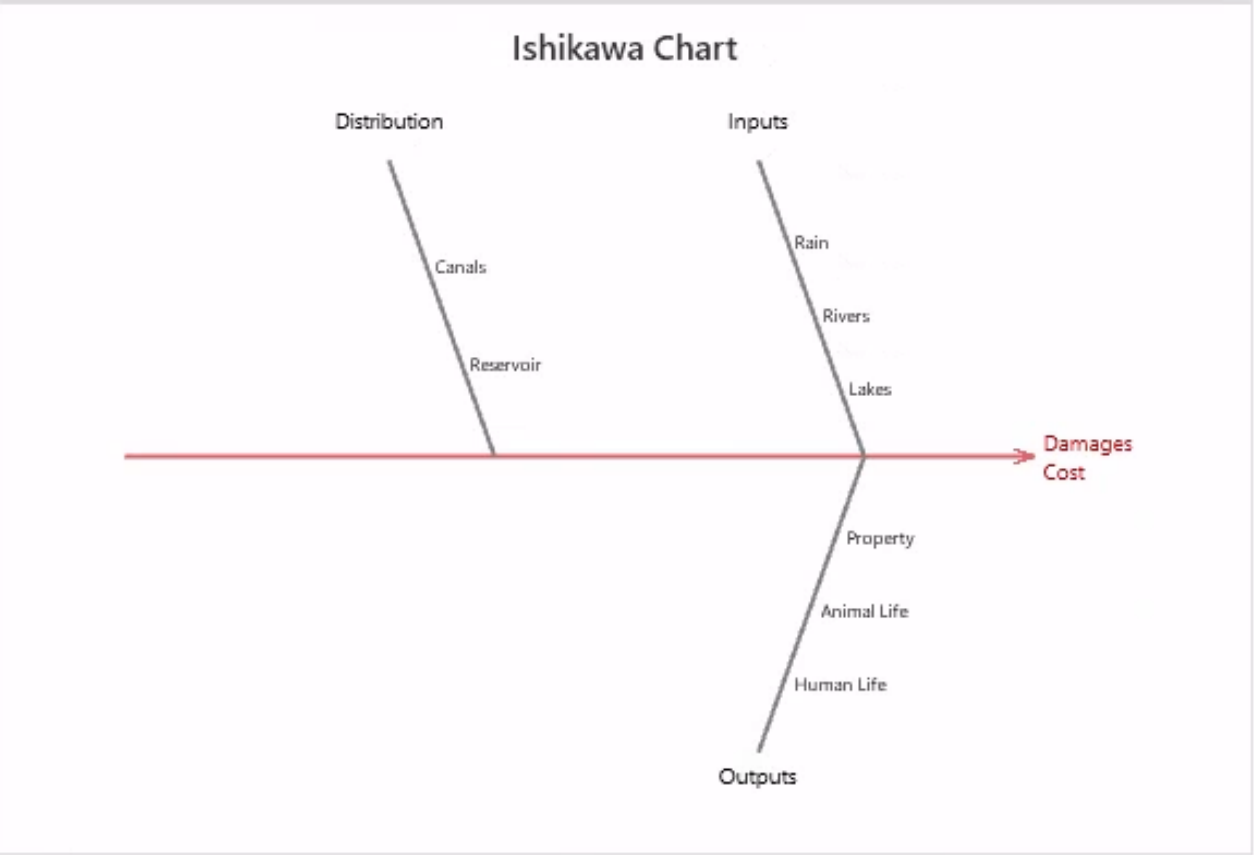
Pseudocode: Flooding

START
Is daily rain distribution known? No. Find it.
Is daily evacuation rate known? No. Find it.
Is upper limit of evacuation know? No. Find it.
Are number of canals know? No. Find it.
Are dimensions of canals know? No. Find it.
Are number of reservoirs known? No. Find it.
Is loss of life known? No. Find it.
Is damage in property and cattle known? No. Find it.
END
Implement a brainstorming session: analyze results
Implement a distribution analysis for key variables
Assess whether variables fulfill systems needs

Brainstorming and Ishikawa

Inputs	Outputs	Distribution
Rain	Human Life	Canals
Rivers	Animal Life	Evacuation Reservoirs
Lakes	Property	Pumps
Marsh		

Ichikawa/Fishbone Diagram: This provides a description of how problem factors affect responses or performance measures. This qualitative diagram can become a model for quantitative regression.

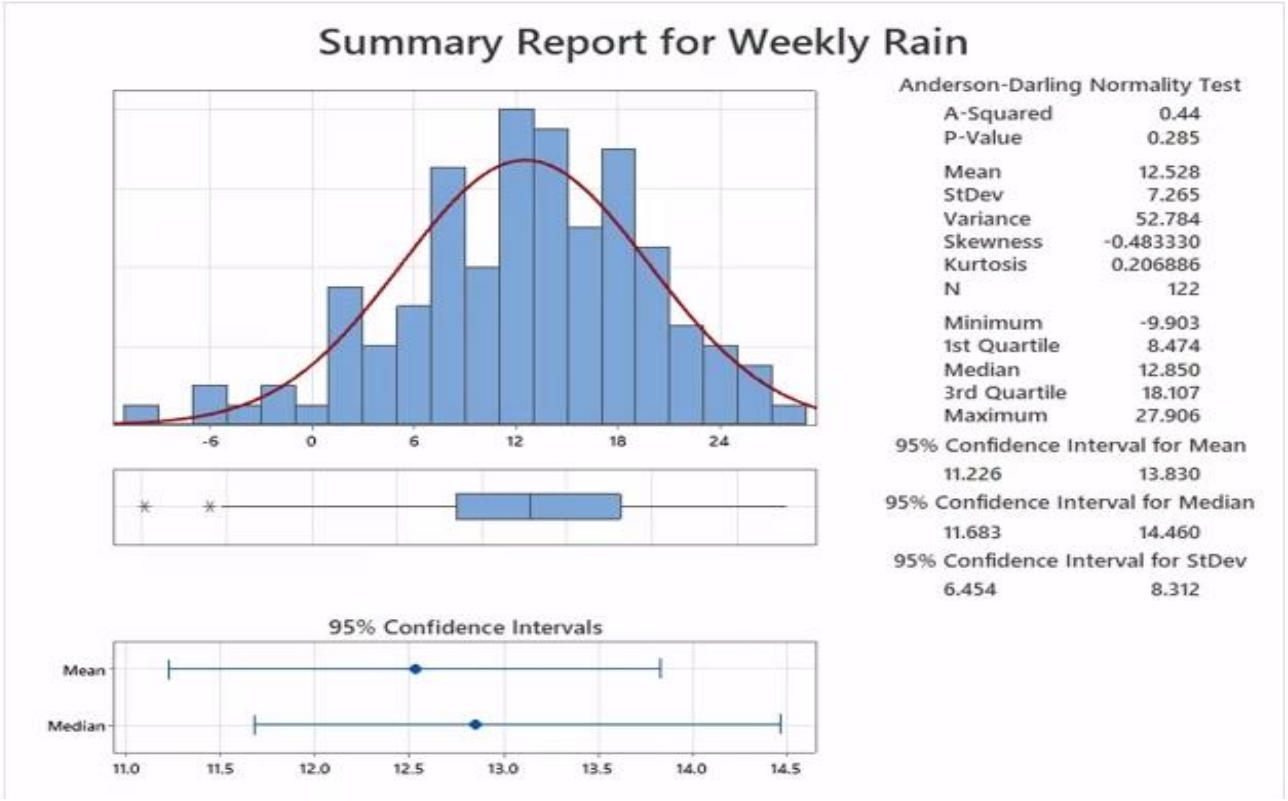


Cost of Poor Quality for Flooding

COPQ	**Flooding**			
Process	Internal Failures	External	Apprasials	Prevention
Evacutation Canals	Blocked Canals	Loss of life Property damage	Weekly inspection	Periodic Cleaning
Evacutation Canals	Small capacity	Loss of life Property damage	Weekly Measure	Canal Modification
Reserviors	Small capacity	Loss of life Property damage	Weekly Measure	Reservoir Modification

For flooding it is crucial to determine whether input (rainfall) is < output (water evacuated). If this condition is not met, improvement project will be to create a system that meets this requirement.

Weekly Rain Distribution (cm)



We will need the rain distribution to plan to meet the requirements of rain evacuation, or what additional resources will be necessary for this. Data has been found for total daily precipitation for Havana, Cuba. This data needs to be processed in Python, but it will give a realistic rain distribution, with proper standard deviation. (Current distribution is inaccurate, and shows “negative” rain)

Overview of Improvement Work

- Determine monthly rainfall, evacuation rate, storage
- Determine if current evacuation rate fulfills system requirements
- Determine canal number and capacity
- Determine if this capacity exists or needs to be created
- Determine how water will be evacuated, canals, rivers, reservoirs
- Determine how water will be distributed throughout evacuation system
- Determine how evacuation system will be managed
- Determine costs of Flooding and improvement project

Conclusion

- Excess water problem needs to be solved
- Cost of flooding is larger than cost of improvement project
- Key information needs to be found from pseudocode
- Continue by defining CTQ (critical) issues
- Rank critical issues by importance, monetary
- Leadership needs to be convinced of project need
- Concludes initial assessment phase
- Next is the Six Sigma analysis