Hurricane Harvey Analysis

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Background and Scope

This report provides an overview of the data import and preprocessing steps performed for the "StormEvents_2017_finalProject.csv" dataset.

Import the Data

The data was imported into MATLAB using the "importdata2017" function. This function is custom-made for loading the specific dataset.

```
clear;
close;
clc;

format longG;

data = importdata2017("StormEvents_2017_finalProject.csv");
```

A few sample rows of the "data" table are shown below:

```
head(data,5);
```

State	Month	Event_Type	CZ_Name	Begin_Date_Time	End_Date_Time	Injuries
NEW JERSEY	April	Thunderstorm Wind	GLOUCESTER	2017-04-06 15:09:00	2017-04-06 15:09:00	0
FLORIDA	April	Tornado	LEE	2017-04-06 09:30:00	2017-04-06 09:40:00	1
OHIO	April	Thunderstorm Wind	GREENE	2017-04-05 17:49:00	2017-04-05 17:53:00	0
OHIO	April	Flood	CLERMONT	2017-04-16 17:59:00	2017-04-16 19:00:00	0
NEBRASKA	April	Hail	CASS	2017-04-15 15:50:00	2017-04-15 15:50:00	0

Two States Most Impacted by Harvey

The focus of this section is to identify and analyze storm events related to Hurricane Harvey in specific states. The states impacted by Harvey include:

- Arkansas
- Kentucky
- Louisiana
- Mississippi
- North Carolina
- Tennessee
- Texas

For our analysis, we assume that the Harvey related events occurred between the 17th of August and the 3rd of September in the year 2017.

The resulting "data_Harvey" table contains the storm events related to Hurricane Harvey in the specified states during the defined period. This filtered dataset can now be used for further analysis and visualization specific to the impact of Hurricane Harvey on the mentioned states.

```
Harvey_States = upper({'Arkansas', 'Kentucky', 'Louisiana', 'Mississippi', ...
    'North Carolina', 'Tennessee', 'Texas'});

data_Harvey = data(data.Begin_Date_Time>=datetime(2017,8,17)...
    & data.Begin_Date_Time<=datetime(2017,9,3)...
    & data.End_Date_Time<=datetime(2017,9,3)...
    & ismember(data.State, Harvey_States)...
    & data.Event_Type ~= 'Heat',:);

data_Harvey.State = removecats(data_Harvey.State);
data_Harvey.Event_Type = removecats(data_Harvey.Event_Type);
```

A few sample rows of the "data_Harvey" table are shown below:

```
head(data_Harvey,5);
```

State	Month	Event_Type	CZ_Name	Begin_Date_Time	End_Date_Time	In
TEXAS	August	Tropical Storm	MONTGOMERY	2017-08-25 12:00:00	2017-08-30 00:00:00	
MISSISSIPPI	September	Strong Wind	LOWNDES	2017-09-01 01:00:00	2017-09-01 01:00:00	
NORTH CAROLINA	September	Flash Flood	WAKE	2017-09-01 17:35:00	2017-09-01 18:15:00	
NORTH CAROLINA	September	Flash Flood	CUMBERLAND	2017-09-01 19:20:00	2017-09-01 21:25:00	
NORTH CAROLINA	September	Hail	LEE	2017-09-01 15:20:00	2017-09-01 15:20:00	

Group the filtered "data_Harvey" table based on the "State" column. The resulting "summary_table_Harvey_States" presents a summary of each state's impact.

The "summary_table_Harvey_States" table provides a concise overview of the states impacted by Hurricane Harvey and the corresponding counts of Harvey-related events in each state.

To identify the two states most impacted by Hurricane Harvey, sort the "summary_table_Harvey_States" in descending order based on the "GroupCount" column.

The two states with the highest count of Harvey-related events are obtained from the sorted summary table. Extract the names of the two most impacted states and store them in the variable "TwoMostImpactedStates". Thus, the most affected states are Texas and Louisiana.

```
summary_table_Harvey_States = groupsummary(data_Harvey,"State");

summary_table_Harvey_States = sortrows(summary_table_Harvey_States, "GroupCount",
"descend")
```

summary_table_Harvey_States = 7×2 table

	State	GroupCount
1	TEXAS	258
2	LOUISIANA	68
3	NORTH CARO...	59
4	TENNESSEE	45
5	ARKANSAS	36
6	MISSISSIPPI	31
7	KENTUCKY	20

```
TwoMostImpactedStates = summary_table_Harvey_States.State(1:2)
```

```
TwoMostImpactedStates = 2×1 categorical
TEXAS
LOUISIANA
```

Table of Events for Texas and Louisiana

To focus on the events that occurred in the two most impacted states, the "events_TMIS" table is created from the filtered "data_Harvey" table. This new table contains only the events that belong to Texas and Louisiana.

```
events_TMIS = data_Harvey(...
    ismember(data_Harvey.State,TwoMostImpactedStates),:);

events_TMIS.State = removecats(events_TMIS.State);
events_TMIS.Event_Type = removecats(events_TMIS.Event_Type);
```

A few sample rows of the "events_TMIS" table are shown below:

```
head(events_TMIS,5);
```

State	Month	Event_Type	CZ_Name	Begin_Date_Time	End_Date_Time	Injuries_Direc
TEXAS	August	Tropical Storm	MONTGOMERY	2017-08-25 12:00:00	2017-08-30 00:00:00	0
TEXAS	August	Tropical Storm	FORT BEND	2017-08-26 00:00:00	2017-08-30 00:00:00	0
TEXAS	August	Tropical Storm	GALVESTON	2017-08-25 12:00:00	2017-08-30 00:00:00	0

```
TEXAS    August    Tropical Storm    SAN JACINTO    2017-08-25 12:00:00    2017-08-30 00:00:00          0
TEXAS    August    Tropical Storm    WALKER         2017-08-25 12:00:00    2017-08-30 00:00:00          0
```

Visualizations

The main purpose of this visualization is to provide a spatial representation of the distribution of events in the affected regions.

Figure of Event Types

To visualize the distribution of events related to Hurricane Harvey in the two most impacted states, Texas and Louisiana, a heatmap was generated using the "events_TMIS" table.

The heatmap displays the number of occurrences for each event type in Texas and Louisiana. Each cell in the heatmap represents the count of events of a particular type in a specific state.

```
figure();
heatmap(events_TMIS,"State","Event_Type");
xlabel("State");
ylabel("Event Type");
title("Events in the Two Most Impacted States ");
```

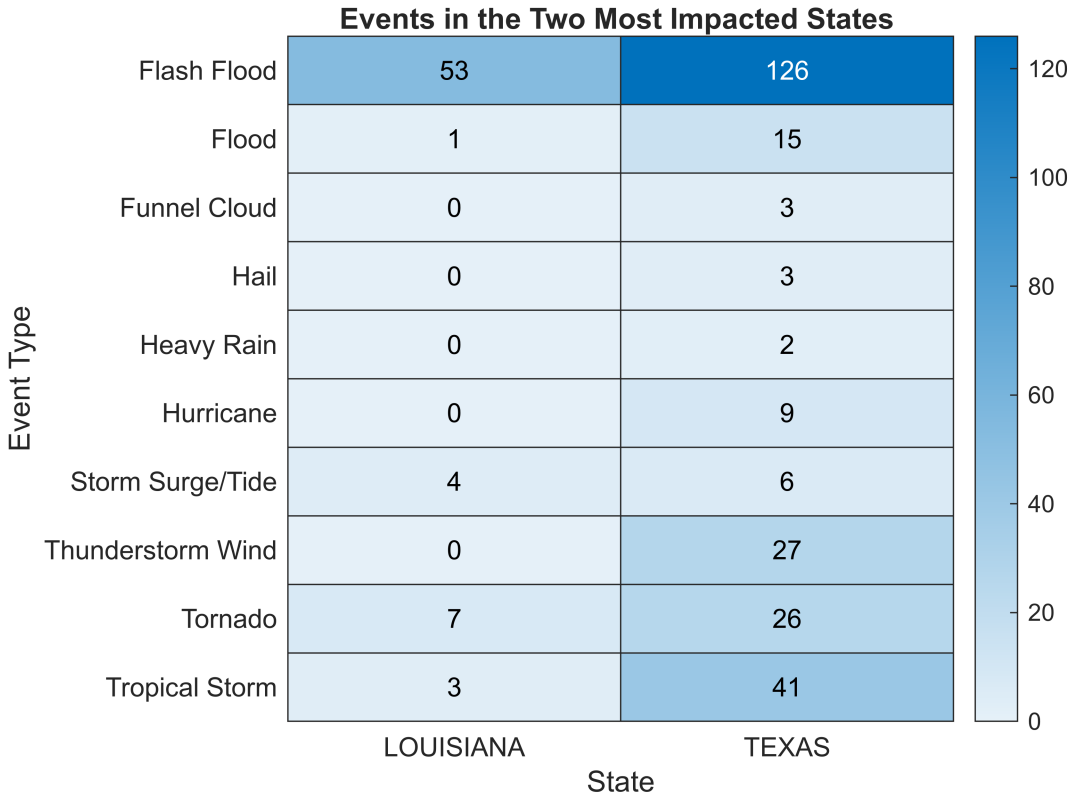


Figure of Event Locations

In the "Event Locations" plot, the geographic locations of weather events related to Hurricane Harvey in Texas and Louisiana are displayed. Before plotting the data, all missing values were removed from the dataset to

ensure accurate visualization. The variable "State1Plot" ans "State2Plot" contains the filtered data for Texas and Louisiana respective. These datasets represent only valid events with available latitude and longitude information.

```
State1Plot = events_TMIS(~isnan(events_TMIS.Begin_Lat)...
       & events_TMIS.State==TwoMostImpactedStates(1),:);
```

A few sample rows of the "State1Plot" table are shown below:

```
head(State1Plot,5)
```

State	Month	Event_Type	CZ_Name	Begin_Date_Time	End_Date_Time	Injuries_Direct
TEXAS	August	Flash Flood	EL PASO	2017-08-23 16:15:00	2017-08-23 17:15:00	0
TEXAS	August	Thunderstorm Wind	EL PASO	2017-08-25 18:10:00	2017-08-25 18:10:00	0
TEXAS	August	Flash Flood	EL PASO	2017-08-25 18:48:00	2017-08-25 20:00:00	0
TEXAS	August	Flash Flood	HARDIN	2017-08-27 12:40:00	2017-08-30 16:00:00	0
TEXAS	August	Flash Flood	JASPER	2017-08-29 22:29:00	2017-08-30 16:00:00	0

```
State2Plot = events_TMIS(~isnan(events_TMIS.Begin_Lat)...
       & events_TMIS.State==TwoMostImpactedStates(2),:);
```

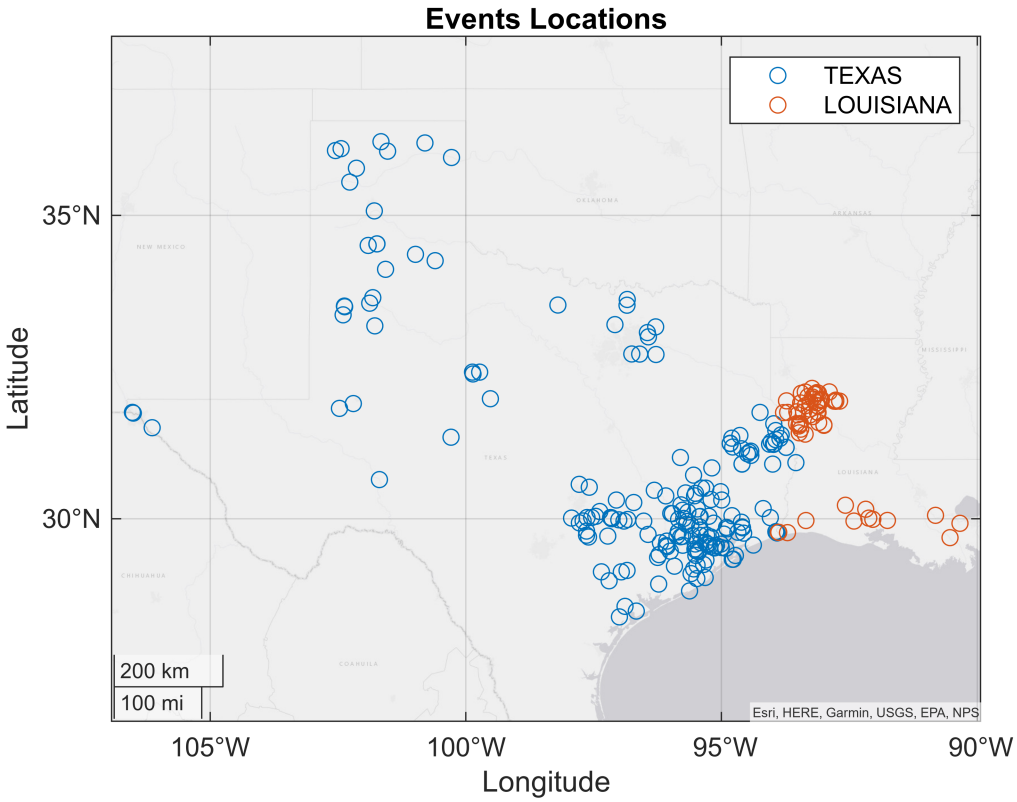
A few sample rows of the "State2Plot" table are shown below:

```
head(State2Plot,5)
```

State	Month	Event_Type	CZ_Name	Begin_Date_Time	End_Date_Time	Injuries_Direct
LOUISIANA	August	Flash Flood	SABINE	2017-08-30 11:56:00	2017-08-31 07:00:00	0
LOUISIANA	August	Flash Flood	SABINE	2017-08-30 12:00:00	2017-08-31 07:00:00	0
LOUISIANA	August	Flash Flood	SABINE	2017-08-30 12:59:00	2017-08-31 07:00:00	0
LOUISIANA	August	Flash Flood	RED RIVER	2017-08-30 12:59:00	2017-08-31 07:00:00	0
LOUISIANA	August	Flash Flood	SABINE	2017-08-30 12:59:00	2017-08-31 07:00:00	0

```
figure();
geoscatter(State1Plot.Begin_Lat,State1Plot.Begin_Lon)
hold on;
geoscatter(State2Plot.Begin_Lat,State2Plot.Begin_Lon)
hold off;

legend(string(TwoMostImpactedStates(1)),string(TwoMostImpactedStates(2)));
title("Events Locations");
```



The "Event Locations" plot provides valuable insights into the spatial distribution of weather events, offering a visual representation of the impact of Hurricane Harvey on both states. It helps researchers and analysts identify clusters and patterns of events in each region, aiding in the assessment of the hurricane's geographical reach and severity.

Analysis

In this section, the data has been prepared for further analysis by isolating events in the two most impacted states. Subsets of the dataset were created, namely "State1" containing events in Texas and "State2" containing events in Louisiana. These subsets will serve as the basis for deeper exploration and examination of the weather events that occurred in each county of the states.

```
State1 = events_TMIS(events_TMIS.State==TwoMostImpactedStates(1),:);
```

A few sample rows of the "State1" table are shown below:

```
head(State1,5);
```

State	Month	Event_Type	CZ_Name	Begin_Date_Time	End_Date_Time	Injuries_Direc
TEXAS	August	Tropical Storm	MONTGOMERY	2017-08-25 12:00:00	2017-08-30 00:00:00	0
TEXAS	August	Tropical Storm	FORT BEND	2017-08-26 00:00:00	2017-08-30 00:00:00	0
TEXAS	August	Tropical Storm	GALVESTON	2017-08-25 12:00:00	2017-08-30 00:00:00	0
TEXAS	August	Tropical Storm	SAN JACINTO	2017-08-25 12:00:00	2017-08-30 00:00:00	0
TEXAS	August	Tropical Storm	WALKER	2017-08-25 12:00:00	2017-08-30 00:00:00	0

```
State2 = events_TMIS(events_TMIS.State==TwoMostImpactedStates(2),:);
```

A few sample rows of the "State2" table are shown below:

```
head(State2,5);
```

State	Month	Event_Type	CZ_Name	Begin_Date_Time	End_Date_Time	Injuries_
LOUISIANA	August	Tropical Storm	SABINE	2017-08-30 16:45:00	2017-08-30 22:30:00	0
LOUISIANA	August	Tropical Storm	NATCHITOCHES	2017-08-30 16:45:00	2017-08-30 22:30:00	0
LOUISIANA	August	Tropical Storm	UNION	2017-08-30 16:45:00	2017-08-30 22:30:00	0
LOUISIANA	August	Flash Flood	SABINE	2017-08-30 11:56:00	2017-08-31 07:00:00	0
LOUISIANA	August	Flash Flood	SABINE	2017-08-30 12:00:00	2017-08-31 07:00:00	0

Three Counties with Most Events in Texas

The objective is to gain insights into the regions that were most severely affected by Hurricane Harvey and understand the areas that require special attention and resources in terms of disaster response and recovery efforts.

To achieve this analysis, a dataset named "State1" was prepared by filtering all the events that occurred in Texas during the specified time frame related to Hurricane Harvey. The "State1" dataset was further used to perform a group summary based on county names ("CZ_Name") to count the occurrences of events in each county within Texas.

```
ThreeCountiesS1 = groupcounts(State1,"CZ_Name");
ThreeCountiesS1 = sortrows(ThreeCountiesS1, "GroupCount", "descend");
```

A few sample rows of the "ThreeCountiesS1" table are shown below:

```
head(ThreeCountiesS1,5);
```

CZ_Name	GroupCount	Percent
HARRIS	20	7.75193798449612
GALVESTON	17	6.58914728682171
FORT BEND	13	5.03875968992248
BRAZORIA	12	4.65116279069767
ANGELINA	11	4.26356589147287

```
Top3S1ME = ThreeCountiesS1.CZ_Name(1:3)
```

```
Top3S1ME = 3×1 categorical
HARRIS
GALVESTON
FORT BEND
```

From the analysis, the three counties with the highest number of events in Texas during Hurricane Harvey were identified as follows:

1. Harris
2. Galveston
3. Fort Bend

Three Counties with Most Events in Louisiana

```
ThreeCountiesS2 = groupcounts(State2,"CZ_Name");
ThreeCountiesS2 = sortrows(ThreeCountiesS2, "GroupCount", "descend");
```

A few sample rows of the "ThreeCountiesS2" table are shown below:

```
head(ThreeCountiesS2,5);
```

CZ_Name	GroupCount	Percent
NATCHITOCHES	20	29.4117647058824
SABINE	14	20.5882352941176
RED RIVER	8	11.7647058823529
WINN	5	7.35294117647059
VERMILION	4	5.88235294117647

```
Top3S2ME = ThreeCountiesS2.CZ_Name(1:3)
```

```
Top3S2ME = 3×1 categorical
NATCHITOCHES
SABINE
RED RIVER
```

A similar analysis for Louisiana yielded the following counties:

1. Natchitoches
2. Sabine
3. Red River

These counties had the highest number of weather-related events during Hurricane Harvey in Louisiana.

Three Counties with Highest Property Cost in Texas

For the analysis of property costs in Texas the relevant columns, were extracted for further analysis.

Next, a summary of property costs for each county was computed using the groupsummary function, grouping the data by "CZ_Name" and summing the "Property_Cost" values for each county. The results were sorted in descending order based on the total property cost.

```
State1PC = State1(~isnan(State1.Property_Cost),["State" "CZ_Name" "Event_Type"
"Property_Cost"]);
```

A few sample rows of the "State1PC" table are shown below:

```
head(State1PC,5);
```

State	CZ_Name	Event_Type	Property_Cost
TEXAS	MONTGOMERY	Tropical Storm	7000000000
TEXAS	FORT BEND	Tropical Storm	8000000000
TEXAS	GALVESTON	Tropical Storm	10000000000

```
TEXAS    SAN JACINTO    Tropical Storm       350000000
TEXAS    WALKER         Tropical Storm       600000000
```

```
ThreeCountiesS1PC = groupsummary(State1PC,"CZ_Name","sum","Property_Cost");

ThreeCountiesS1PC = sortrows(ThreeCountiesS1PC, "sum_Property_Cost", "descend");
```

A few sample rows of the "ThreeCountiesS1PC" table are shown below:

```
head(ThreeCountiesS1PC,5);
```

CZ_Name	GroupCount	sum_Property_Cost
GALVESTON	17	20000201500
FORT BEND	13	16004330000
MONTGOMERY	6	14000000000
HARRIS	20	10000730000
JEFFERSON	4	3000000000

```
Top3S1PC = ThreeCountiesS1PC.CZ_Name(1:3)
```

```
Top3S1PC = 3×1 categorical
GALVESTON
FORT BEND
MONTGOMERY
```

The top three counties with the highest reported property costs in Texas were identified as follows:

1. Galveston: With a reported property cost of $20,000,201,500
2. Fort Bend: With a reported property cost of $16,004,330,000
3. Montgomery: With a reported property cost of $14,000,000,000

Three Counties with Highest Property Cost in Louisiana

```
State2PC = State2(~isnan(State2.Property_Cost),["State" "CZ_Name" "Event_Type"
"Property_Cost"]);
```

A few sample rows of the "State2PC" table are shown below:

```
head(State2PC,5);
```

State	CZ_Name	Event_Type	Property_Cost
LOUISIANA	SABINE	Tropical Storm	0
LOUISIANA	NATCHITOCHES	Tropical Storm	0
LOUISIANA	UNION	Tropical Storm	0
LOUISIANA	SABINE	Flash Flood	0
LOUISIANA	SABINE	Flash Flood	0

```
ThreeCountiesS2PC = groupsummary(State2PC,"CZ_Name","sum","Property_Cost");

ThreeCountiesS2PC = sortrows(ThreeCountiesS2PC, "sum_Property_Cost", "descend");
```

A few sample rows of the "ThreeCountiesS2PC" table are shown below:

```
head(ThreeCountiesS2PC,5);
```

CZ_Name	GroupCount	sum_Property_Cost
CALCASIEU	1	60000000
BEAUREGARD	1	15000000
ACADIA	1	200000
CAMERON	3	72000
VERMILION	4	5000

```
Top3S2PC = ThreeCountiesS2PC.CZ_Name(1:3)
```

```
Top3S2PC = 3×1 categorical
CALCASIEU
BEAUREGARD
ACADIA
```

A similar analysis for Louisiana yielded the following counties in Louisiana with the highest reported property costs related to Hurricane Harvey are as follows:

1. Calcasieu: With a reported property cost of $60,000,000
2. Beauregard: With a reported property cost of $15,000,000
3. Acadia: With a reported property cost of $200,000

Conclusions and Recommendations

Based on the data analysis conducted for the events related to Hurricane Harvey in Texas and Louisiana, the following recommendation is proposed:

Recommendation: Send outside contractors to assist with claims filing in the following counties.

For Texas:

1. Harris
2. Galveston
3. Fort Bend

For Louisiana:

1. Natchitoches
2. Sabine
3. Red River

These counties were identified as the most impacted regions in their respective states based on the number of events and reported property costs.