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wanjirumwangi206-alt

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📖 README

AIRCRAFT ACCIDENT ANALYSIS

BUSINESS UNDERSTANDING

Manhattan Limited is planning to venture into the aviation industry by buying and operating commercial and private aircraft.The company has limited knowledge and clear understanding of the safety and risk profiles of different aircraft.

Aircraft accidents can lead to major financial losses, legal liabilities, damaged reputation and safety risk for passengers and staff.Because of this , it is essential for the company to make decisions based on facts from prior data from the aviation industry to be able to choose which aircraft models to invest in that minimize risks.

This analsis aims to review historical aviation accident data to identify types of aircraft with highest operation risk. These findings will help management pick safer and more reliable aircraft for the company's new aviation division.

PROJECT OBJECTIVES

- 1.To analyse aircraft accident trends over time.
- 2.To identify aircraft types with the highest accidents rates.
- 3.To evaluate which type of damage level has the most fatalities.
- 4.To analyze which operators have the highest accidents.
- 5.To generate insights and recommendations that management can use to guide aircraft purchasing decisons

DATA UNDERSTANDING

```
#importing necessary libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

#loading dataset
df = pd.read_csv('flight.csv')
df

<style scoped> .dataframe tbody tr th:only-of-type { vertical-align: middle; }

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    vertical-align: top;
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.dataframe thead th {
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</style>
```

	Unnamed: 0	acc.date	type	reg	operator	fat	location	dmg
0	0	3 Jan 2022	British Aerospace 4121 Jetstream 41	ZS-NRJ	SA Airlink	0	near Venetia Mine Airport	sub
1	1	4 Jan 2022	British Aerospace 3101 Jetstream 31	HR-AYY	LANHSA - Línea Aérea Nacional de Honduras S.A	0	Roatán-Juan Manuel Gálvez International Airpor...	sub
2	2	5 Jan 2022	Boeing 737-4H6	EP-CAP	Caspian Airlines	0	Isfahan-Shahid Beheshti Airport (IFN)	sub
3	3	8 Jan 2022	Tupolev Tu-204-100C	RA-64032	Cainiao, opb Aviastar-TU	0	Hangzhou Xiaoshan International Airport (HGH)	w/o
4	4	12 Jan 2022	Beechcraft 200 Super King Air	NaN	private	0	Machakilha, Toledo District, Grahem Creek area	w/o
...
2495	1245	20 Dec 2018	Cessna 560 Citation V	N188CW	Chen Aircrafts LLC	4	2 km NE of Atlanta-Fulton County Airport, GA (...)	w/o
2496	1246	22 Dec 2018	PZL-Mielec M28 Skytruck	GNB-96107	Guardia Nacional Bolivariana de Venezuela - GNBV	0	Kamarata Airport (KTV)	sub
2497	1247	24 Dec 2018	Antonov An-26B	9T-TAB	Air Force of the Democratic Republic of the Congo	0	Beni Airport (BNC)	w/o
2498	1248	31 Dec 2018	Boeing 757-2B7 (WL)	N938UW	American Airlines	0	Charlotte-Douglas International Airport, NC (C...	sub
2499	1249	unk. date 2018	Rockwell Sabreliner 80	N337KL	private	0	Eugene Airport, OR (EUG)	sub

2500 rows × 8 columns

```
# looking at datatypes and missing values
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2500 entries, 0 to 2499
Data columns (total 8 columns):
 #   Column      Non-Null Count  Dtype
---  -
 0   Unnamed: 0   2500 non-null   int64
 1   acc.date     2500 non-null   object
 2   type         2500 non-null   object
 3   reg          2408 non-null   object
 4   operator     2486 non-null   object
 5   fat          2488 non-null   object
 6   location     2500 non-null   object
 7   dmg          2500 non-null   object
dtypes: int64(1), object(7)
memory usage: 156.4+ KB
```

```
# checking missing value
df.isna().sum()
```

```
Unnamed: 0      0
acc.date        0
type            0
reg             92
operator        14
fat             12
location        0
dmg             0
dtype: int64
```

df.columns

```
#Checking for rows and columns
df.shape
```

```
(2500, 8)
```

```
# checking for duplicates
df.duplicated().value_counts()
```

```
False    1250
True      1250
Name: count, dtype: int64
```

DATA PREPARATION

```
#Sorting duplicates
df[df.duplicated(keep=False)].sort_values(by='type')
df
```

```
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}
```

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.dataframe thead th {
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2499	1249	unk. date 2018	Rockwell Sabreliner 80	N337KL	private	0	Eugene Airport, OR (EUG)	sub

2500 rows × 8 columns

```
#Dropping duplicates
df = df.drop_duplicates()
df
```

<style scoped> .dataframe tbody tr th:only-of-type { vertical-align: middle; }

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```

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1249	1249	unk. date 2018	Rockwell Sabreliner 80	N337KL	private	0	Eugene Airport, OR (EUG)	sub

1250 rows × 8 columns

```
#Dropping duplicates
df = df.drop_duplicates()
df
```

```
<style scoped> .dataframe tbody tr th:only-of-type { vertical-align: middle; }
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1247	1247	24 Dec 2018	Antonov An-26B	9T-TAB	Air Force of the Democratic Republic of the Congo	0	Beni Airport (BNC)	w/o
1248	1248	31 Dec 2018	Boeing 757-2B7 (WL)	N938UW	American Airlines	0	Charlotte-Douglas International Airport, NC (C...	sub
1249	1249	unk. date 2018	Rockwell Sabreliner 80	N337KL	private	0	Eugene Airport, OR (EUG)	sub

1250 rows × 8 columns

#Remove unnecessary index column 'Unnamed: 0'
if 'Unnamed: 0' in df.columns:
df = df.drop(columns=['Unnamed: 0'])
df

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vertical-align: top;
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.dataframe thead th {
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	acc.date	type	reg	operator	fat	location	dmg
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2	5 Jan 2022	Boeing 737-4H6	EP-CAP	Caspian Airlines	0	Isfahan-Shahid Beheshti Airport (IFN)	sub

	acc.date	type	reg	operator	fat	location	dmg
3	8 Jan 2022	Tupolev Tu-204-100C	RA-64032	Cainiao, opb Aviastar-TU	0	Hangzhou Xiaoshan International Airport (HGH)	w/o
4	12 Jan 2022	Beechcraft 200 Super King Air	NaN	private	0	Machakilha, Toledo District, Grahem Creek area	w/o
...
1245	20 Dec 2018	Cessna 560 Citation V	N188CW	Chen Aircrafts LLC	4	2 km NE of Atlanta-Fulton County Airport, GA (...)	w/o
1246	22 Dec 2018	PZL-Mielec M28 Skytruck	GNB-96107	Guardia Nacional Bolivariana de Venezuela - GNBV	0	Kamarata Airport (KTV)	sub
1247	24 Dec 2018	Antonov An-26B	9T-TAB	Air Force of the Democratic Republic of the Congo	0	Beni Airport (BNC)	w/o
1248	31 Dec 2018	Boeing 757-2B7 (WL)	N938UW	American Airlines	0	Charlotte-Douglas International Airport, NC (C...	sub
1249	unk. date 2018	Rockwell Sabreliner 80	N337KL	private	0	Eugene Airport, OR (EUG)	sub

1250 rows × 7 columns

Selecting relevant columns

rel_columns = ['acc.date', 'type', 'operator', 'fat', 'dmg']
df = df[rel_columns]
df.head()

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vertical-align: top;
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.dataframe thead th {
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	acc.date	type	operator	fat	dmg
0	3 Jan 2022	British Aerospace 4121 Jetstream 41	SA Airlink	0	sub
1	4 Jan 2022	British Aerospace 3101 Jetstream 31	LANHSA - Línea Aérea Nacional de Honduras S.A	0	sub
2	5 Jan 2022	Boeing 737-4H6	Caspian Airlines	0	sub
3	8 Jan 2022	Tupolev Tu-204-100C	Cainiao, opb Aviastar-TU	0	w/o
4	12 Jan 2022	Beechcraft 200 Super King Air	private	0	w/o

#naming the columns properly

df.columns = ['acc.date', 'aircraft_type', 'operator', 'fatalities', 'damage']
df.head()

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vertical-align: top;
}

.dataframe thead th {

```
text-align: right;
}

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	acc.date	aircraft_type	operator	fatalities	damage
0	3 Jan 2022	British Aerospace 4121 Jetstream 41	SA Airlink	0	sub
1	4 Jan 2022	British Aerospace 3101 Jetstream 31	LANHSA - Línea Aérea Nacional de Honduras S.A	0	sub
2	5 Jan 2022	Boeing 737-4H6	Caspian Airlines	0	sub
3	8 Jan 2022	Tupolev Tu-204-100C	Cainiao, opb Aviastar-TU	0	w/o
4	12 Jan 2022	Beechcraft 200 Super King Air	private	0	w/o



# Remove rows where 'acc.date' is empty after cleaning
df = df.copy()
#Ensuring the date is in a string
df['acc.date'] = df['acc.date'].astype(str)
#Removing 'xx' and ' ' and replacing with False
df['acc.date'] = df['acc.date'].str.replace('xx', '', regex=False)
#Removing unk.date, and replacing with false
df['acc.date'] = df['acc.date'].str.replace('unk. date', '', regex=False)
# Removing spaces in our string
df['acc.date'] = df['acc.date'].str.strip()
# Convert to datetime
df['acc.date'] = pd.to_datetime(df['acc.date'], errors='coerce')
#Converting acc.date from object to datetime
# Drop rows where conversion failed (NaT)
df = df.dropna(subset=['acc.date'])
df['acc.date']

0      2022-01-03
1      2022-01-04
2      2022-01-05
3      2022-01-08
4      2022-01-12
...
1244   2018-12-20
1245   2018-12-20
1246   2018-12-22
1247   2018-12-24
1248   2018-12-31
Name: acc.date, Length: 1247, dtype: datetime64[ns]

# Extract year from 'acc.date' and create a new column
df['year'] = df['acc.date'].dt.year
df

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.dataframe thead th {
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	acc.date	aircraft_type	operator	fatalities	damage	year
0	2022-01-03	British Aerospace 4121 Jetstream 41	SA Airlink	0	sub	2022


```

| | acc.date | aircraft_type | operator | fatalities | damage | year |
|------|------------|-------------------------------------|---|------------|--------|------|
| 1 | 2022-01-04 | British Aerospace 3101 Jetstream 31 | LANHSA - Línea Aérea Nacional de Honduras S.A | 0 | sub | 2022 |
| 2 | 2022-01-05 | Boeing 737-4H6 | Caspian Airlines | 0 | sub | 2022 |
| 3 | 2022-01-08 | Tupolev Tu-204-100C | Cainiao, opb Aviastar-TU | 0 | w/o | 2022 |
| 4 | 2022-01-12 | Beechcraft 200 Super King Air | private | 0 | w/o | 2022 |
| ... | ... | ... | ... | ... | ... | ... |
| 1244 | 2018-12-20 | Antonov An-26B | Gomair | 7 | w/o | 2018 |
| 1245 | 2018-12-20 | Cessna 560 Citation V | Chen Aircrafts LLC | 4 | w/o | 2018 |
| 1246 | 2018-12-22 | PZL-Mielec M28 Skytruck | Guardia Nacional Bolivariana de Venezuela - GNBV | 0 | sub | 2018 |
| 1247 | 2018-12-24 | Antonov An-26B | Air Force of the Democratic Republic of the Congo | 0 | w/o | 2018 |
| 1248 | 2018-12-31 | Boeing 757-2B7 (WL) | American Airlines | 0 | sub | 2018 |

1247 rows x 6 columns

#Remove spaces

df['aircraft_type'] = df['aircraft_type'].str.strip()
Standardize Capitalization
df['aircraft_type'] = df['aircraft_type'].str.title()
df['aircraft_type']

0 British Aerospace 4121 Jetstream 41
1 British Aerospace 3101 Jetstream 31
2 Boeing 737-4H6
3 Tupolev Tu-204-100C
4 Beechcraft 200 Super King Air
...
1244 Antonov An-26B
1245 Cessna 560 Citation V
1246 Pzl-Mielec M28 Skytruck
1247 Antonov An-26B
1248 Boeing 757-2B7 (WL)
Name: aircraft_type, Length: 1247, dtype: object

#Cleaning Operator column

#Remove spaces
df['operator'] = df['operator'].str.strip()
Standardize Capitalization
df['operator'] = df['operator'].str.title()
df['operator'] = df['operator'].fillna('unknown')
df['operator']

0 Sa Airlink
1 Lanhsa - Línea Aérea Nacional De Honduras S.A
2 Caspian Airlines
3 Cainiao, Opb Aviastar-Tu
4 Private
...
1244 Gomair
1245 Chen Aircrafts Llc

```

1246      Guardia Nacional Bolivariana De Venezuela - Gnbv
1247      Air Force Of The Democratic Republic Of The Congo
1248      American Airlines
Name: operator, Length: 1247, dtype: object

```

```

# Cleaning Fatalities column
#Converting from a string to numeric, filling missing values and making it an integer
df['fatalities'] = pd.to_numeric(df['fatalities'], errors='coerce').fillna(0).astype(int)
df['fatalities']

```

```

0      0
1      0
2      0
3      0
4      0
..
1244    7
1245    4
1246    0
1247    0
1248    0
Name: fatalities, Length: 1247, dtype: int32

```

```

# Strip whitespace and lowercase
df['damage'] = df['damage'].str.strip().str.lower()

# Replace shorthand codes with full,standardized labels
df['damage'] = df['damage'].replace({'sub': 'Substantial','w/o': 'Written Off','non': 'None','min': 'Minor','mis': 'Missing','unl': 'Unknown'})

#Fill any missing values
df['damage'] = df['damage'].fillna('Unknown')
df['damage']

```

```

0      Substantial
1      Substantial
2      Substantial
3      Written Off
4      Written Off
...
1244  Written Off
1245  Written Off
1246  Substantial
1247  Written Off
1248  Substantial
Name: damage, Length: 1247, dtype: object

```

```
df.to_csv("aircraft_accidents_cleaned.csv", index=False)
```

DATA ANALYSIS

```

#Grouping the data by year
accidents_per_year = df.groupby(df['acc.date'].dt.year).size()
accidents_per_year.head()

```

```

acc.date
2018    284
2019    295
2020    234
2021    216
2022    218
dtype: int64

```

```
# Plotting how many accidents were there each year to see the trend
plt.figure(figsize=(10,6))
# Line with markers
plt.plot(accidents_per_year.index, accidents_per_year.values, marker='*', color='blue', linewidth=1)
# Labels and title
plt.xlabel('Year')
plt.ylabel('Number of Accidents')
plt.title('Aircraft Accidents per Year')
# Make x-axis show all years
plt.xticks(accidents_per_year.index, rotation=90)
# grid
plt.grid(True, linestyle='--', alpha=0.5)
plt.show()
```



```
accidents_per_type = df['aircraft_type'].value_counts()
accidents_per_type
```

```
aircraft_type
Cessna 208B Grand Caravan      57
Beechcraft 200 Super King Air  29
Antonov An-2R                  28
De Havilland Canada Dhc-6 Twin Otter 300  17
Cessna 208 Caravan I           15
..
Boeing 767-375Er               1
Boeing 747-412 (Bcf)           1
Boeing 747-412F (Scd)          1
Boeing 737-76N (W1)            1
Boeing 757-2B7 (W1)            1
Name: count, Length: 522, dtype: int64
```

```
# Identify aircraft types with the highest accidents rates .
#Count how many accidents each aircraft type has
accidents_per_type = df['aircraft_type'].value_counts()
#Select the top 10 aircraft types with the highest accident counts
top_10_aircraft = accidents_per_type.head(10)
# Plot a horizontal bar chart
plt.figure(figsize=(12,6))
top_10_aircraft.sort_values().plot(kind='bar', color='black')
plt.title('Top 10 Aircraft Types with Highest Accident Counts')
plt.xlabel('Aircraft Type')
plt.ylabel('Number of Accidents')
plt.show()
```



```
# which operators had the highest accidents
```

```
accidents_per_operator = df['operator'].value_counts()
top_10_operators = accidents_per_operator.head(10)
plt.figure(figsize=(12,6))
top_10_operators.sort_values().plot(kind='bar', color='skyblue')
plt.title('Top 10 Operators by Number of Accidents', fontsize=16)
plt.xlabel('Operator', fontsize=12)
plt.ylabel('Number of Accidents', fontsize=12)
plt.show()
```



```
#evaluate the fatalities with the type of damage level
fatalities= df['fatalities'].value_counts()
#Total fatalities per aircraft type
fatalities_by_damage = df.groupby('damage')['fatalities'].sum().sort_values(ascending=False)
```

```
# Total accidents by damage ype
damage_summary = df['damage'].value_counts()

# Visualize
plt.figure(figsize=(10,5))
plt.bar(x=fatalities_by_damage.index, height=fatalities_by_damage.values, color='red')
plt.title("Total Fatalities by Damage Level")
plt.xlabel('Damage Type')
plt.ylabel("Total Fatalities")
plt.show()
```



FINDINGS

- 1.The highest number of accidents were in 2019, followed by 2018.Accidents dropped significantly in 2020-2021,due to COVID-19 lockdowns, with a slight increase in 2022 as aviation operations resumed.
- 2.The Cessna 208B Grand Caravan experienced most accidents, followed by Beechcraft 200 Super King Air, Antonov An-2R, De Havilland Canada DHC-6 Twin Otter 300, and Cessna 208 Caravan I.
- 3.Aircraft classified as 'written off' show the highest fatality rates, while accidents with 'substantial' damage resulted in relatively few fatalities.This indicates that more severe damage generally corresponds to higher fatalities.
- 4.Private operators experienced the highest number of accidents, highlighting a potential area for strict safety oversight.

Recommendations

- 1.After COVID-19, more safety measures should be taken as operations resume to normalcy and also standards to be raised to curb COVID-19 like testing our clients for it to prevent the spread.
- 2.Purchases should be made on flights with the lowest accidents rates.If need be to purchase flights with high risk extra caution on safety should be taken seriously and thoroughly with very regular maintenace .



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