ITD 112 Laboratory Exercises #2

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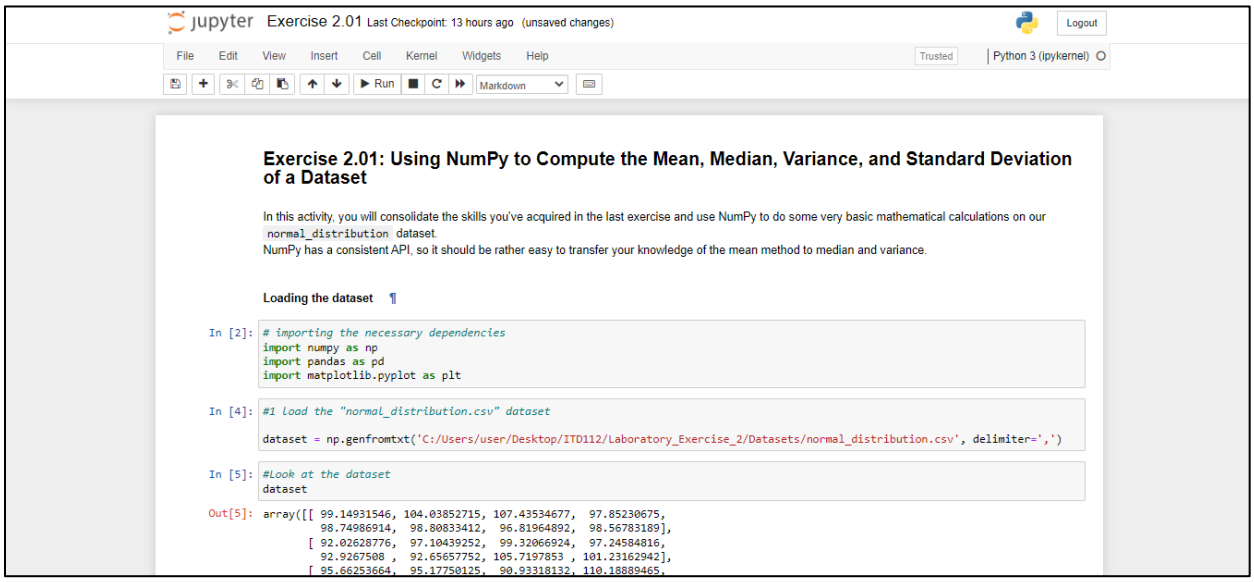
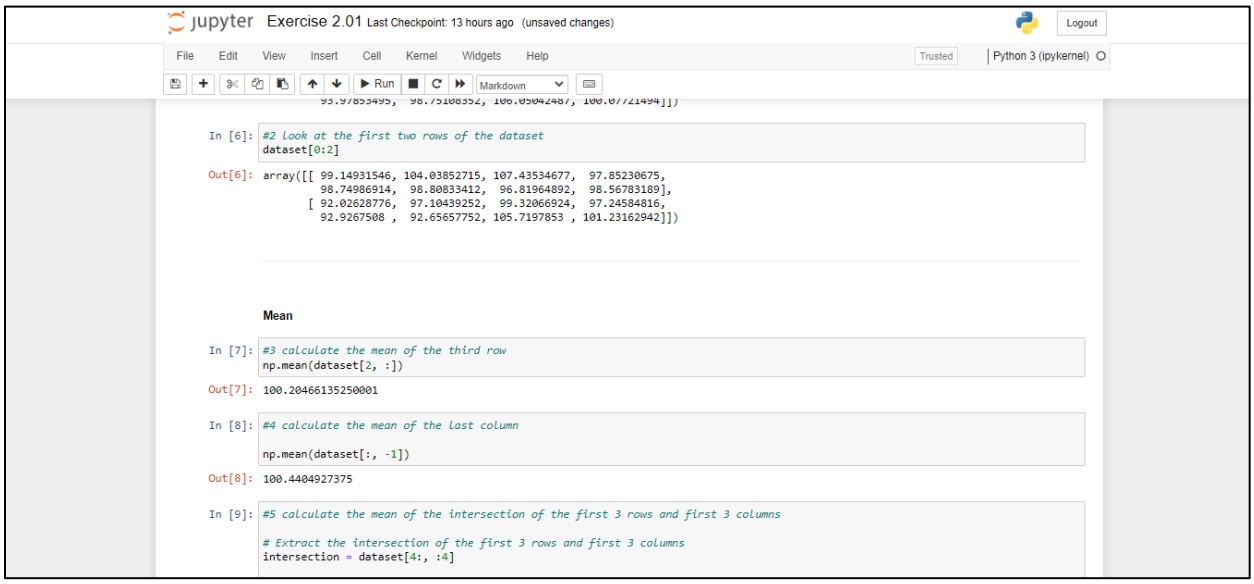
Complete the codes of the following exercises. Screenshot your output. Submit in pdf format.

Source Code Link: https://github.com/kiyojiii/ITD112

Exercise 2.01: Using NumPy to Compute the Mean, Median, Variance, and Standard Deviation of a Dataset





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Out[8]: 100.4404927375

In [9]:
```
#5 calculate the mean of the intersection of the first 3 rows and first 3 columns

# Extract the intersection of the first 3 rows and first 3 columns
intersection = dataset[4:, :4]

# Calculate the Mean of the intersection
intersection_mean = np.mean(intersection)

print(intersection_mean)
```

```
100.80743067
```

Median

In [10]:
```
#6 calculate the median of the last row

np.median(dataset[-1, :])
```

Out[10]: 99.18748092

In [11]:
```
#7 calculate the median of the last 3 columns

np.median(dataset[:, -3])
```

Out[11]: 99.0841696500001

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In [12]:
```
#8 calculate the median of each row

np.median(dataset, axis=1)
```

Out[12]:
```
array([ 98.77910163,  97.17512034,  98.58782879, 100.68449836,
       101.00170737,  97.76908825, 101.85002253, 100.04756697,
       102.24292555,  99.59514997, 100.4955753 ,  99.8860714 ,
        99.00647994,  98.67276177, 102.44376222,  96.61933565,
       104.0968893 , 100.72023043,  98.70877396,  99.75008654,
       104.89344428, 101.00634942,  98.30543801,  99.18748092])
```

Variance

In [13]:
```
#10 calculate the variance of each column

np.var(dataset, axis=0)
```

Out[13]:
```
array([23.64757465, 29.78886109, 20.50542011, 26.03204443, 28.38853175,
       19.09960817, 17.67291174, 16.17923204])
```

In [14]:
```
#11 calculate the variance of the intersection of the last 2 rows and first 2 columns

# Extract the intersection of the last 2 rows and first 2 columns
intersection = dataset[-3:, :3]

# Calculate the variance of the intersection
variance_intersection = np.var(intersection)
```

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19.09960817, 17.67291174, 16.17923204])

In [14]:
```
#11 calculate the variance of the intersection of the last 2 rows and first 2 columns

# Extract the intersection of the last 2 rows and first 2 columns
intersection = dataset[-3:, :3]

# Calculate the variance of the intersection
variance_intersection = np.var(intersection)

print(variance_intersection)
```

```
16.046702056236402
```

The values of the variance might seem a little bit strange at first.
You can always go back to the topic that gives you a quick statistical overview to recap what you've learned so far.

> **Note:**
> Just remember, the variance is not the standard deviation.

Try calculation the standard deviation with NumPy to get a more descriptive value when comparing it to our dataset

In [32]:
```
#12 calculate the standard deviation for the dataset

# Calculate the standard deviation for the entire dataset
std_deviation = np.std(dataset)

print(std_deviation)
```

```
4.838197554269257
```

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GRAPH ----------

In [29]:
```
# Calculate mean, median, variance, and standard deviation
mean = np.mean(dataset)
median = np.median(dataset)
variance = np.var(dataset)
std_deviation = np.std(dataset)

# Create labels for the points
labels = ['Mean', 'Median', 'Variance', 'Std Deviation']

# Values for each point
values = [mean, median, variance, std_deviation]

# Define custom colors for the line and markers
line_color = 'purple'
marker_color = 'orange'

# Values for the horizontal bar graph
bar_values = [mean, median, variance, std_deviation]

# Bar graph colors
bar_colors = ['blue', 'green', 'purple', 'orange']

# Create a figure with two subplots side by side
fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(12, 6))

# Plot the line graph in the first subplot
ax1.plot(labels, values, marker='o', linestyle='-', color=line_color, markersize=8, markerfacecolor=marker_color)
ax1.set_xlabel('Statistics')
```

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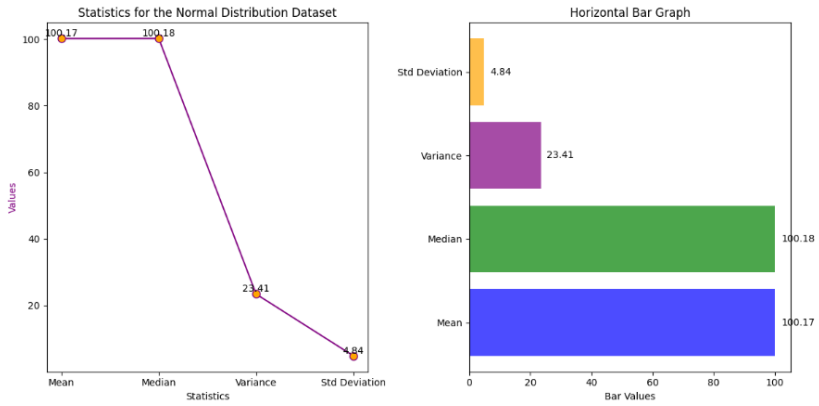
```
# Show the plot with both line and horizontal bar graphs
plt.show()
```



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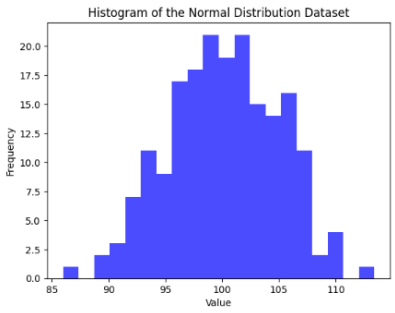
In [17]:
```
# Flatten the dataset into a 1D array
data = dataset.flatten()

# Create a histogram with 20 bins
plt.hist(data, bins=20, color='blue', alpha=0.7)

# Add labels and title
plt.xlabel('Value')
plt.ylabel('Frequency')
plt.title('Histogram of the Normal Distribution Dataset')

# Show the histogram
plt.show()
```



Exercise 2.02: Forest Fire Size and Temperature Analysis

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Exercise 2.02: Forest Fire Size and Temperature Analysis

In this activity, we will use pandas features to derive some insights from a forest fire dataset. We will get the mean size of forest fires, what the largest recorded fire in our dataset is, and whether the amount of forest fires grows proportionally to the temperature in each month.

Loading the dataset

In [26]:
```
# importing the necessary dependencies
import pandas as pd
import matplotlib.pyplot as plt
```

In [3]:
```
#1 load the "forestfires.csv" dataset

dataset = pd.read_csv('C:/Users/user/Desktop/ITD112/Laboratory_Exercise_2/Datasets/forestfires.csv', index_col=0)
```

In [4]:
```
dataset
```

Out[4]:

X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
7	5	mar	fri	86.2	26.2	94.3	5.1	8.2	51	6.7	0.0	0.00
7	4	oct	tue	90.6	35.4	669.1	6.7	18.0	33	0.9	0.0	0.00
7	4	oct	sat	90.6	43.7	686.9	6.7	14.6	33	1.3	0.0	0.00
8	6	mar	fri	91.7	33.3	77.5	9.0	8.3	97	4.0	0.2	0.00
8	6	mar	sun	89.3	51.3	102.2	9.6	11.4	99	1.8	0.0	0.00
...	...	...	...	...	...	...	...	...	...	...	...	...
4	3	aug	sun	81.6	56.7	665.6	1.9	27.8	32	2.7	0.0	6.44
6	3	nov	tue	79.5	3.0	106.7	1.1	11.8	31	4.5	0.0	0.00

517 rows × 12 columns

In [5]:
```
#2 looking at the first two rows of the dataset
dataset[0:2]
```

Out[5]:

X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
7	5	mar	fri	86.2	26.2	94.3	5.1	8.2	51	6.7	0.0	0.0
7	4	oct	tue	90.6	35.4	669.1	6.7	18.0	33	0.9	0.0	0.0

The dataset contains:

- X - x-axis spatial coordinate within the Montesinho park map: 1 to 9
- Y - y-axis spatial coordinate within the Montesinho park map: 2 to 9
- **month - month of the year: 'jan' to 'dec'**
- day - day of the week: 'mon' to 'sun'
- FFMC - FFMC index from the FWI system: 18.7 to 96.20
- DMC - DMC index from the FWI system: 1.1 to 291.3
- DC - DC index from the FWI system: 7.9 to 860.6
- ISI - ISI index from the FWI system: 0.0 to 56.10
- **temp - temperature in Celsius degrees: 2.2 to 33.30**
- RH - relative humidity in %: 15.0 to 100
- wind - wind speed in km/h: 0.40 to 9.40
- rain - outside rain in mm/m2 : 0.0 to 6.4
- **area - the burned area of the forest (in ha): 0.00 to 1090.84**

Note:
The fields that we'll be working with are highlighted in the listing.

Create a new dataset that only contains the entries with an area value of > 0.

In [16]:
```
#3 filter the dataset for rows that have an area > 0
filtered_dataset = dataset[dataset['area'] > 0]
print(filtered_dataset)
```

```
     Y month  day  FFMC    DMC     DC   ISI  temp  RH  wind  rain   area
X
9    9   jul  tue  85.8   48.3  313.4   3.9  18.0  42   2.7   0.0   0.36
1    4   sep  tue  91.0  129.5  692.6   7.0  21.7  38   2.2   0.0   0.43
2    5   sep  mon  90.9  126.5  686.5   7.0  21.9  39   1.8   0.0   0.47
1    2   aug  wed  95.5   99.9  513.3  13.2  23.3  31   4.5   0.0   0.55
8    6   aug  fri  90.1  108.0  529.8  12.5  21.2  51   8.9   0.0   0.61
.. ..  ...  ...   ...    ...    ...   ...   ...  ..   ...   ...    ...
5    4   aug  fri  91.0  166.9  752.6   7.1  21.1  71   7.6   1.4   2.17
6    5   aug  fri  91.0  166.9  752.6   7.1  18.2  62   5.4   0.0   0.43
4    3   aug  sun  81.6   56.7  665.6   1.9  27.8  32   2.7   0.0   6.44
2    4   aug  sun  81.6   56.7  665.6   1.9  21.9  71   5.8   0.0  54.29
7    4   aug  sun  81.6   56.7  665.6   1.9  21.2  70   6.7   0.0  11.16

[270 rows x 12 columns]
```

After filtering out the zero area entries, we can simply use the `mean` method of pandas to get the mean area size of the forest fires for the filtered down dataset not containing zero area sizes.

Get the mean value for the `area` column of out filtered dataset.

In [17]:
```
#4 get the mean value for the area column
mean_area = filtered_dataset['area'].mean()
print(mean_area)
```

```
24.600185185185182
```

In addition to that, looking at the largest and smallest non-zero area can help us understand the range of possible area sizes. Let's get more insights into that.

- Use the `min` and `max` methods to see the smallest and largest area that has been affected by a forest fire

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In addition to that, looking at the largest and smallest non-zero area can help us understand the range of possible area sizes. Let's get more insights into that.

- Use the `min` and `max` methods to see the smallest and largest area that has been affected by a forest fire.
- Use the `std` method to get insights into how much variation there is in our dataset.

In [18]:
```
#5 get the smallest area value from our dataset
smallest_area = filtered_dataset['area'].min()
print(smallest_area)
```

```
0.09
```

In [19]:
```
#6 get the largest area value from our dataset
largest_area = filtered_dataset['area'].max()
print(largest_area)
```

```
1090.84
```

In [20]:
```
#7 get the standard deviation of values in our dataset
std_deviation = filtered_dataset['area'].std()
print(std_deviation)
```

```
86.50163460412126
```

The largest value is much larger than our mean.
The standard deviation also is quite large which indicates that the difference between our mean and the "middle value" will be quite high.

Let's look at the last 20 values of our sorted dataset to see if we have more than one very large value.
Sort the filtered dataset by the `area` column and output the last 20 entries from it.

In [21]:
```
#8 sorting the filtered dataset and printing the last 20 elements
sorted_dataset = filtered_dataset.sort_values(by='area', ascending=False)
last_20_entries = sorted_dataset.tail(20)
print(last_20_entries)
```

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Sort the filtered dataset by the `area` column and output the last 20 entries from it.

In [21]:
```
#8 sorting the filtered dataset and printing the last 20 elements
sorted_dataset = filtered_dataset.sort_values(by='area', ascending=False)
last_20_entries = sorted_dataset.tail(20)
print(last_20_entries)
```

```
    Y month  day  FFMC    DMC     DC  ISI  temp  RH  wind  rain  area
X
2   4   aug  wed  92.2   91.6  503.6  9.6  20.7  70   2.2   0.0  0.75
1   3   sep  sat  91.2   94.3  744.4  8.4  22.3  48   4.0   0.0  0.72
1   2   jul  sat  90.0   51.3  296.3  8.7  16.6  53   5.4   0.0  0.71
8   5   aug  wed  93.1  157.3  666.7 13.5  26.8  25   3.1   0.0  0.68
4   3   aug  sat  94.2  117.2  581.1 11.0  21.4  44   2.7   0.0  0.68
8   6   aug  fri  90.1  108.0  529.8 12.5  21.2  51   8.9   0.0  0.61
1   2   aug  wed  95.5   99.9  513.3 13.2  23.3  31   4.5   0.0  0.55
8   6   aug  mon  92.1  207.0  672.6  8.2  26.8  35   1.3   0.0  0.54
2   2   aug  tue  92.1  152.6  658.2 14.3  21.8  56   3.1   0.0  0.52
7   4   sep  fri  88.2   55.2  732.3 11.6  15.2  64   3.1   0.0  0.52
2   5   sep  mon  90.9  126.5  686.5  7.0  21.9  39   1.8   0.0  0.47
6   5   aug  fri  91.0  166.9  752.6  7.1  18.2  62   5.4   0.0  0.43
1   4   sep  tue  91.0  129.5  692.6  7.0  21.7  38   2.2   0.0  0.43
7   4   sep  sun  89.6   84.1  714.3  5.7  17.1  53   5.4   0.0  0.41
9   9   jul  tue  85.8   48.3  313.4  3.9  18.0  42   2.7   0.0  0.36
1   3   sep  fri  91.1   91.3  738.1  7.2  19.1  46   2.2   0.0  0.33
8   5   aug  wed  93.1  157.3  666.7 13.5  24.0  36   3.1   0.0  0.24
6   5   aug  wed  93.1  157.3  666.7 13.5  22.1  37   3.6   0.0  0.21
6   5   aug  tue  94.3  131.7  607.1 22.7  19.4  55   4.0   0.0  0.17
5   4   aug  sun  91.8  175.1  700.7 13.8  25.7  39   5.4   0.0  0.09
```

As we can see here, only 11 out of the 270 rows contain values that are larger than 100.
After 20 values we are close to the area value of 60.

Let's imagine our dataset contained only 1 or 2 values that were much higher than the other ones, e.g. an area size value of 10254.91. Simply by observing the dataset, this feels like there might have been an error on adding this to the dataset.
In a smaller dataset, the mean value would get heavily distored by this one entry. A more stable value to use in such a case is the median value of the dataset.

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Get the median value for the `area` column.

In [22]:
```
#9 calculate the median value for the area column
median_area = filtered_dataset['area'].median()
print(median_area)
```

```
6.37
```

Note:
Remember that the median is not the same as then mean of your dataset. While the median is simple the "value in the middle", the mean is much more prone to distortion by outliers.

Finding the month with the most forest fires

In this second task we want to quickly see which months have the most forest fires and whether or not the temperature has a direct connection to it.

Get a list of month values that are present in our dataset.

In [23]:
```
#10 get a list of month values from the dataset
unique_months = dataset['month'].unique()
print(unique_months)
```

```
['mar' 'oct' 'aug' 'sep' 'apr' 'jun' 'jul' 'feb' 'jan' 'dec' 'may' 'nov']
```

In addition to the unique values we also want use the shape element of our dataset to determine how many rows it has.

Filter the dataset for only rows that contain the month `mar` and print the number of rows using `shape`.

In [62]:
```
#11 get the number of forest fires for the month of march
fires_in_march = dataset[dataset['month'] == 'mar'].shape[0]
print(fires_in_march)
```

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Run Code

In [62]:
```
#11 get the number of forest fires for the month of march
fires_in_march = dataset[dataset['month'] == 'mar'].shape[0]
print(fires_in_march)
```

```
54
```

The last step to fulfil the task is to iterate over all months, filtering our dataset for the rows containing the given month and calculating the mean temperature.

- Iterate over the months from the unique list we created
- Filter our dataset for the rows containing the given month
- Get the number of rows from `shape`
- Get the mean temperature for the given month
- Print a statement with the number of fires, mean temperature and the month

In [78]:
```
# 12-15
# iterate over the months list
# get number of forest fires for each month
# get mean temperature for each month
# print out number of fires and mean temperature

# Define a custom order for months
custom_month_order = ['jan', 'feb', 'mar', 'apr', 'may', 'jun', 'jul', 'aug', 'sep', 'oct', 'nov', 'dec']

# Get a list of month values from the dataset
unique_months = dataset['month'].unique()

# Iterate over the custom order of months
for month in custom_month_order:
    if month in unique_months:
        month_data = dataset[dataset['month'] == month]
        num_fires = month_data.shape[0]
        mean_temp = month_data['temp'].mean()
        print(f"Month: {month}, Number of Fires: {num_fires}, Mean Temperature: {mean_temp:.2f}")
```

```
Month: jan, Number of Fires: 2, Mean Temperature: 5.25
```

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Run Code

```
        num_fires = month_data.shape[0]
        mean_temp = month_data['temp'].mean()
        print(f"Month: {month}, Number of Fires: {num_fires}, Mean Temperature: {mean_temp:.2f}")
```

```
Month: jan, Number of Fires: 2, Mean Temperature: 5.25
Month: feb, Number of Fires: 20, Mean Temperature: 9.63
Month: mar, Number of Fires: 54, Mean Temperature: 13.08
Month: apr, Number of Fires: 9, Mean Temperature: 12.04
Month: may, Number of Fires: 2, Mean Temperature: 14.65
Month: jun, Number of Fires: 17, Mean Temperature: 20.49
Month: jul, Number of Fires: 32, Mean Temperature: 22.11
Month: aug, Number of Fires: 184, Mean Temperature: 21.63
Month: sep, Number of Fires: 172, Mean Temperature: 19.61
Month: oct, Number of Fires: 15, Mean Temperature: 17.09
Month: nov, Number of Fires: 1, Mean Temperature: 11.80
Month: dec, Number of Fires: 9, Mean Temperature: 4.52
```

GRAPH ----------

In [27]:
```
# Get a list of month values from the dataset
unique_months = dataset['month'].unique()

# Initialize lists to store data for the graph
num_fires_per_month = []
mean_temp_per_month = []

# Iterate over the months list, get the number of forest fires and the mean temperature, and store the data
for month in unique_months:
    month_data = dataset[dataset['month'] == month]
    num_fires = month_data.shape[0]
    mean_temp = month_data['temp'].mean()
    num_fires_per_month.append(num_fires)
    mean_temp_per_month.append(mean_temp)
```

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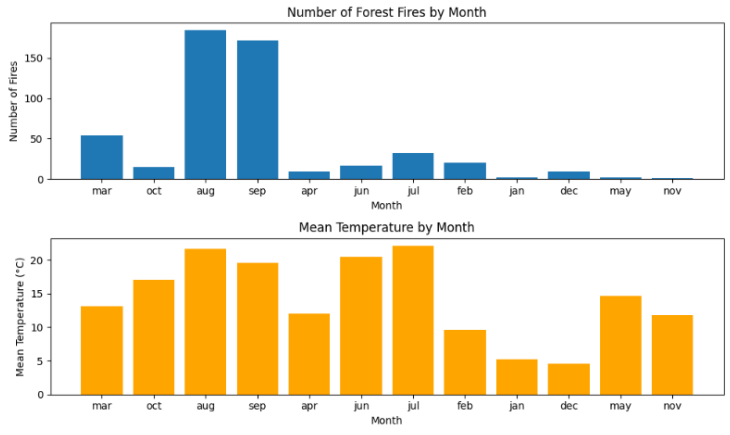
Run Code

```
plt.show()
```



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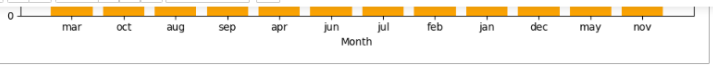

In [77]:

```
# Group the dataset by month and calculate the mean FFMC, DMC, ISI, DC, temp, RH, wind, and rain for each month
all_vars_by_month = dataset.groupby('month')[['FFMC', 'DMC', 'ISI', 'DC', 'temp', 'RH']].mean().reindex(custom_month_order).reset

# Create a beautiful color palette
color_palette = ['#FF5733', '#FFAF33', '#FFD133', '#33FF57', '#33FFD6', '#3387FF', '#8533FF', '#FF33AE']

# Create a figure with six subplots (two rows, three columns)
plt.figure(figsize=(12, 8))

for i, variable in enumerate(['FFMC', 'DMC', 'ISI', 'DC', 'temp', 'RH']):
    plt.subplot(2, 3, i + 1)
    plt.bar(all_vars_by_month['month'], all_vars_by_month[variable], color=color_palette[i])
    plt.xlabel('Month', fontsize=12)
    plt.ylabel(variable, fontsize=12)
    plt.title(f'{variable} by Month (Custom Order)', fontsize=14)

    # Rotate month labels for better readability
    plt.xticks(rotation=45)

    # Add numbers above each bar
    for month, value in zip(all_vars_by_month['month'], all_vars_by_month[variable]):
        plt.text(month, value + 0.5, f'{value:.2f}', ha='center', fontsize=10, fontweight='bold')

# Adjust spacing between subplots
plt.tight_layout()

# Show the combined graphs
plt.show()
```

jupyter Exercise 2.02 Last Checkpoint: 11 hours ago (autosaved)

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Run Code