In [ ]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings('ignore')
```

```
/usr/local/lib/python3.6/dist-packages/statsmodels/tools/_testing.py:19: FutureWarning: p
andas.util.testing is deprecated. Use the functions in the public API at pandas.testing i
nstead.
  import pandas.util.testing as tm
```

In [ ]:

```
df = pd.read_csv('forest_fires.csv')
```

In [ ]:

```
df.head()
```

Out[ ]:

	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
0	7	5	mar	fri	86.2	26.2	94.3	5.1	8.2	51	6.7	0.0	0.0
1	7	4	oct	tue	90.6	35.4	669.1	6.7	18.0	33	0.9	0.0	0.0
2	7	4	oct	sat	90.6	43.7	686.9	6.7	14.6	33	1.3	0.0	0.0
3	8	6	mar	fri	91.7	33.3	77.5	9.0	8.3	97	4.0	0.2	0.0
4	8	6	mar	sun	89.3	51.3	102.2	9.6	11.4	99	1.8	0.0	0.0

In [ ]:

```
df.shape
```

Out[ ]:

```
(517, 13)
```

The Forest fire dataset contains the area of fires based on various parameters. There are 13 parameters out of which "area" is the Dependent variable and rest are Independent variable.

Based on sources, the variables are defined as:

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

In [ ]:

```
# Description of the data
```

```
df.describe()
```

Out[ ]:

	X	Y	FFMC	DMC	DC	ISI	temp	RH	wind	ra
count	517.000000	517.000000	517.000000	517.000000	517.000000	517.000000	517.000000	517.000000	517.000000	517.0000
mean	4.669246	4.299807	90.644681	110.872340	547.940039	9.021663	18.889168	44.288201	4.017602	0.0216
std	2.313778	1.229900	5.520111	64.046482	248.066192	4.559477	5.806625	16.317469	1.791653	0.2959
min	1.000000	2.000000	18.700000	1.100000	7.900000	0.000000	2.200000	15.000000	0.400000	0.0000
25%	3.000000	4.000000	90.200000	68.600000	437.700000	6.500000	15.500000	33.000000	2.700000	0.0000
50%	4.000000	4.000000	91.600000	108.300000	664.200000	8.400000	19.300000	42.000000	4.000000	0.0000
75%	7.000000	5.000000	92.900000	142.400000	713.900000	10.800000	22.800000	53.000000	4.900000	0.0000
max	9.000000	9.000000	96.200000	291.300000	860.600000	56.100000	33.300000	100.000000	9.400000	6.4000

From the dataset description, we can observe following things:

1. **The count for all the variables are same and hence we can say that there are no null values present although we shall check for null values separately for confirmation.**
2. **The minimum area value is 0 which means that there is no burned area.**

In [ ]:

```
df.isnull().any()
```

Out[ ]:

```
X         False
Y         False
month     False
day       False
FFMC      False
DMC       False
DC        False
ISI       False
temp      False
RH        False
wind      False
rain      False
area      False
dtype: bool
```

As Predicted from data description, there are no null values present.

In [ ]:

```
# Data types are correct.
df.dtypes
```

Out[ ]:

```
X          int64
Y          int64
month     object
day       object
FFMC     float64
DMC      float64
DC       float64
ISI      float64
temp     float64
RH         int64
wind     float64
rain     float64
area     float64
dtype: object
```

In [ ]:

```
# Last 5 entries of the dataset
df.tail()
```

Out[ ]:

	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
512	4	3	aug	sun	81.6	56.7	665.6	1.9	27.8	32	2.7	0.0	6.44
513	2	4	aug	sun	81.6	56.7	665.6	1.9	21.9	71	5.8	0.0	54.29
514	7	4	aug	sun	81.6	56.7	665.6	1.9	21.2	70	6.7	0.0	11.16
515	1	4	aug	sat	94.4	146.0	614.7	11.3	25.6	42	4.0	0.0	0.00
516	6	3	nov	tue	79.5	3.0	106.7	1.1	11.8	31	4.5	0.0	0.00

How many areas have 0 entries?

In [ ]:

```
# Lets see how many areas have 0 entries
df[df['area'] == 0]
```

Out[ ]:

	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
0	7	5	mar	fri	86.2	26.2	94.3	5.1	8.2	51	6.7	0.0	0.0
1	7	4	oct	tue	90.6	35.4	669.1	6.7	18.0	33	0.9	0.0	0.0
2	7	4	oct	sat	90.6	43.7	686.9	6.7	14.6	33	1.3	0.0	0.0
3	8	6	mar	fri	91.7	33.3	77.5	9.0	8.3	97	4.0	0.2	0.0
4	8	6	mar	sun	89.3	51.3	102.2	9.6	11.4	99	1.8	0.0	0.0
...	...	...	...	...	...	...	...	...	...	...	...	...	...
507	2	4	aug	fri	91.0	166.9	752.6	7.1	25.9	41	3.6	0.0	0.0
508	1	2	aug	fri	91.0	166.9	752.6	7.1	25.9	41	3.6	0.0	0.0
511	8	6	aug	sun	81.6	56.7	665.6	1.9	27.8	35	2.7	0.0	0.0
515	1	4	aug	sat	94.4	146.0	614.7	11.3	25.6	42	4.0	0.0	0.0
516	6	3	nov	tue	79.5	3.0	106.7	1.1	11.8	31	4.5	0.0	0.0

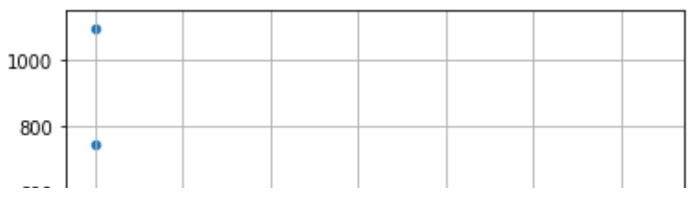
247 rows × 13 columns

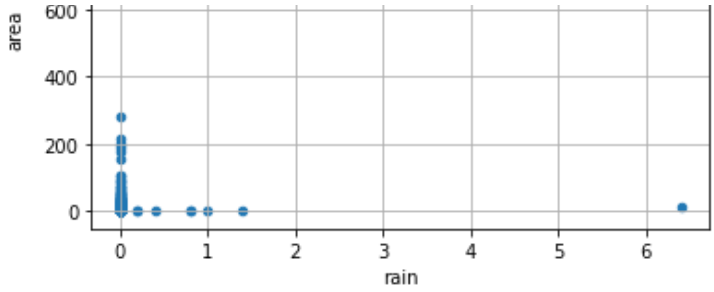
There are 247 rows with zero entries. We can see that there are more zeros in "rain" variable too. Lets see the relation between rain and area.

Plotting area based on Rain

In [ ]:

```
df.plot.scatter('rain', 'area')
plt.grid()
plt.show()
```





We see that for most of the cases where rain is 0, the burnt area is more. Also, as the rain is increased, the area burnt is very less.

In [ ]:

```
zero_rain = df[df['rain'] == 0]
zero_rain
```

Out[ ]:

	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
0	7	5	mar	fri	86.2	26.2	94.3	5.1	8.2	51	6.7	0.0	0.00
1	7	4	oct	tue	90.6	35.4	669.1	6.7	18.0	33	0.9	0.0	0.00
2	7	4	oct	sat	90.6	43.7	686.9	6.7	14.6	33	1.3	0.0	0.00
4	8	6	mar	sun	89.3	51.3	102.2	9.6	11.4	99	1.8	0.0	0.00
5	8	6	aug	sun	92.3	85.3	488.0	14.7	22.2	29	5.4	0.0	0.00
...	...	...	...	...	...	...	...	...	...	...	...	...	...
512	4	3	aug	sun	81.6	56.7	665.6	1.9	27.8	32	2.7	0.0	6.44
513	2	4	aug	sun	81.6	56.7	665.6	1.9	21.9	71	5.8	0.0	54.29
514	7	4	aug	sun	81.6	56.7	665.6	1.9	21.2	70	6.7	0.0	11.16
515	1	4	aug	sat	94.4	146.0	614.7	11.3	25.6	42	4.0	0.0	0.00
516	6	3	nov	tue	79.5	3.0	106.7	1.1	11.8	31	4.5	0.0	0.00

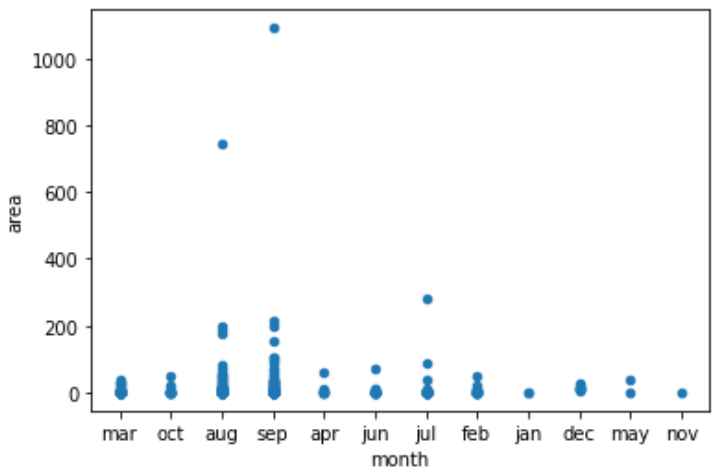
509 rows × 13 columns

zero_rain contains the dataframe for rain value as zero.

Plotting area burnt based on month and day

In [ ]:

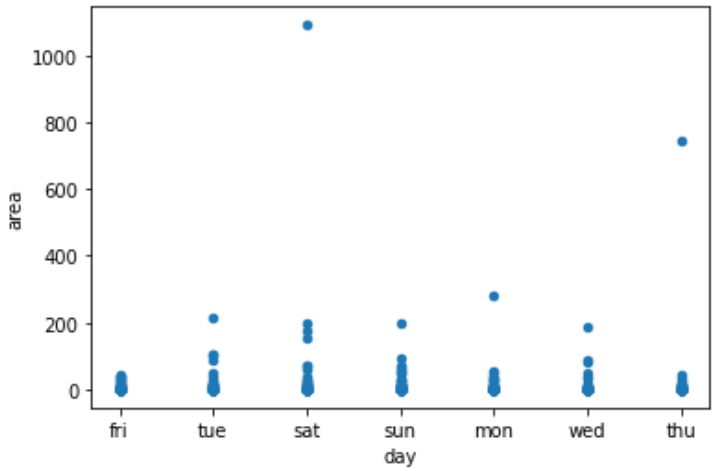
```
df.plot.scatter('month', 'area')
plt.show()
```



From the month analysis, we can observe that the burnt area is maximum in September month following with Aug and July. Also, Novemeber and Jan consists of least amount of area burnt.

In [ ]:

```
df.plot.scatter('day', 'area')
plt.show()
```



From the day analysis, we can observe that the burnt area is maximum on Saturday following with Thursday. So, we can think Saturday on September we have the max area burnt. We shall validate it by get the dataframe of maximum area burnt.

Maximum area burnt

In [ ]:

```
df[df['area'] == df['area'].max()]
```

Out[ ]:

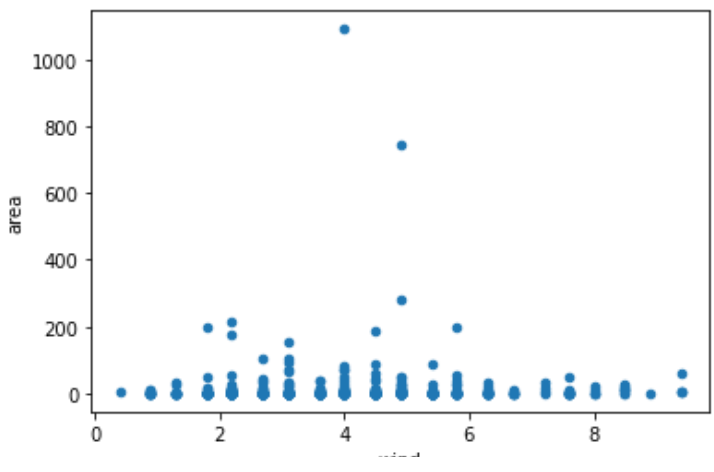
	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
238	6	5	sep	sat	92.5	121.1	674.4	8.6	25.1	27	4.0	0.0	1090.84

From this, we can observe that on Saturday of september, we observed maximum area burnt with '0' mm/m2 amount of rain, '4' km/hr of wind.

Area based on wind and RH

In [ ]:

```
df.plot.scatter('wind', 'area')
plt.show()
```



wind

In [ ]:

```
data = df.groupby('wind')['area'].count()
data
```

Out[ ]:

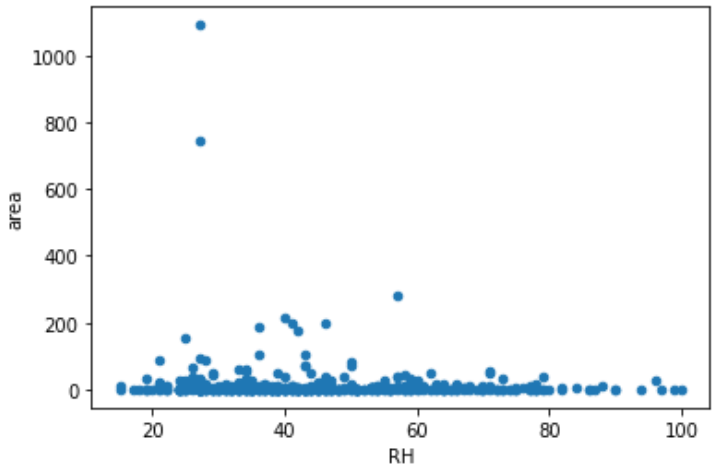
```
wind
0.4      1
0.9     13
1.3     14
1.8     31
2.2     53
2.7     44
3.1     53
3.6     40
4.0     51
4.5     41
4.9     48
5.4     41
5.8     24
6.3     19
6.7      8
7.2      4
7.6     14
8.0      5
8.5      8
8.9      1
9.4      4
Name: area, dtype: int64
```

From wind analysis, we can see that wind value of 4.0 has the highest area burnt and for wind value of 3.1, the area burnt is around 53 times.

RH analysis

In [ ]:

```
df.plot.scatter('RH', 'area')
plt.show()
```



From RH analysis, we can observe that max area burnt is obtained for an RH level of around 25-30.

In [ ]:

```
a = df.groupby('RH')[['area']].mean()
a
```

Out[ ]:

area

RH	area
15	5.53
17	0.00
18	0.00
19	7.93
20	0.00
...	...
94	0.00
96	26.00
97	0.00
99	0.00
100	0.00

75 rows × 1 columns

Analysis based on range between two variables.

In [ ]:

```
data = df[(df['rain']==0) & (df['temp']>30)]
data
```

Out[ ]:

	X	Y	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area
28	6	3	sep	sat	93.4	145.4	721.4	8.1	30.2	24	2.7	0.0	0.00
421	2	4	aug	wed	95.2	217.7	690.0	18.0	30.8	19	4.5	0.0	0.00
480	9	9	jul	thu	93.2	114.4	560.0	9.5	30.2	25	4.5	0.0	2.75
481	4	3	jul	thu	93.2	114.4	560.0	9.5	30.2	22	4.9	0.0	0.00
483	8	6	aug	sun	94.9	130.3	587.1	14.1	31.0	27	5.4	0.0	0.00
484	2	5	aug	sun	94.9	130.3	587.1	14.1	33.1	25	4.0	0.0	26.43
485	2	4	aug	mon	95.0	135.5	596.3	21.3	30.6	28	3.6	0.0	2.07
491	4	4	aug	thu	95.8	152.0	624.1	13.8	32.4	21	4.5	0.0	0.00
492	1	3	aug	fri	95.9	158.0	633.6	11.3	32.4	27	2.2	0.0	0.00
494	6	6	aug	sat	96.0	164.0	643.0	14.0	30.8	30	4.9	0.0	8.59
496	4	5	aug	mon	96.2	175.5	661.8	16.8	32.6	26	3.1	0.0	2.77
497	3	4	aug	tue	96.1	181.1	671.2	14.3	32.3	27	2.2	0.0	14.68
498	6	5	aug	tue	96.1	181.1	671.2	14.3	33.3	26	2.7	0.0	40.54

Here, we are filtering the dataframe based on rain = 0 and temperature = 30degc, in which we can see max area burnt is around 40.54 for temperature = 33.3 degc.

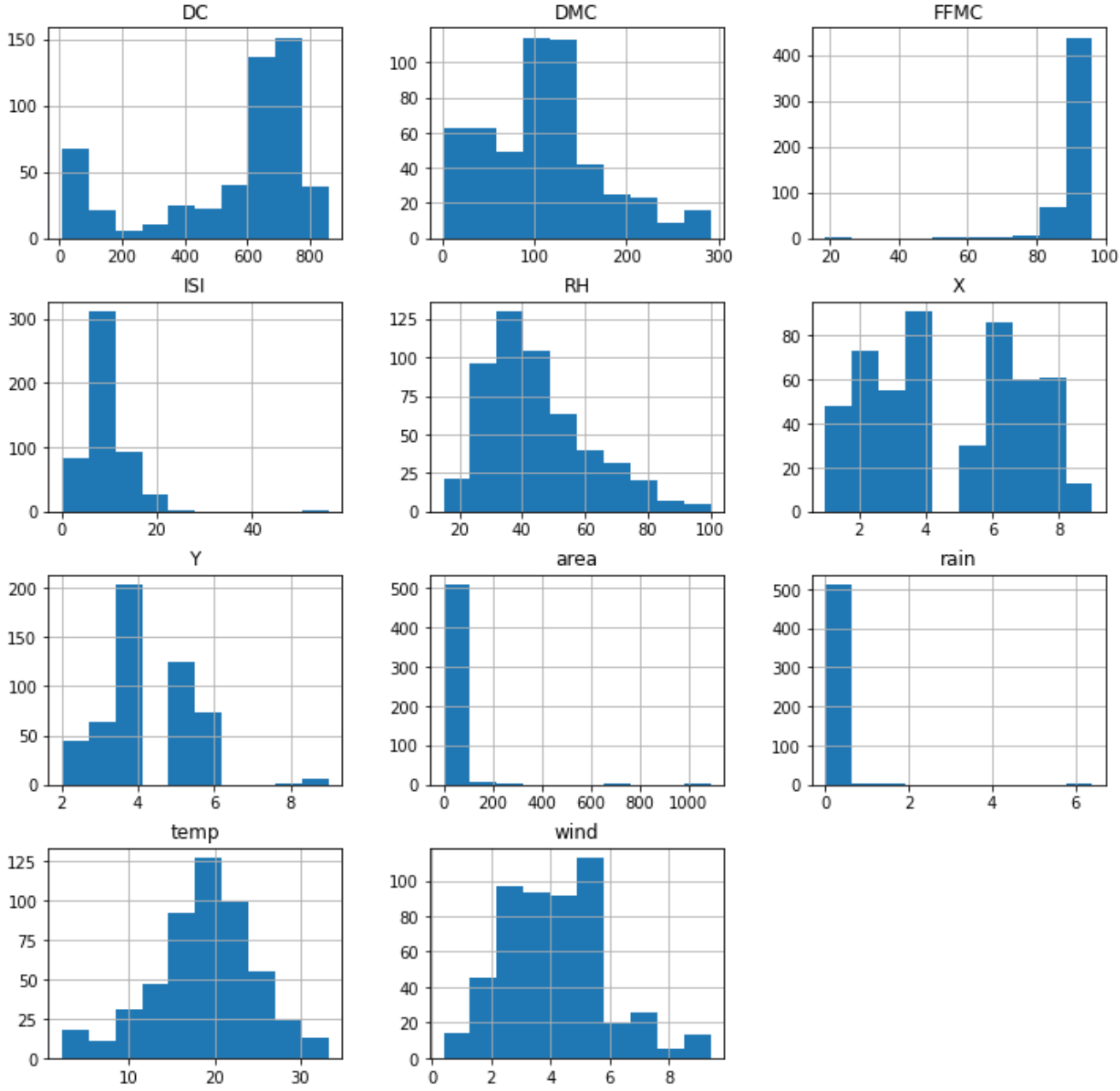
Histogram analysis

HIstogram gives the distribution of each individual varaibles. Based on this, we can identify the amount of skewness present in the variable.

In [ ]:

```
fig = plt.figure(figsize = (12, 12))
```

```
ax = fig.gca()
df.hist(ax = ax)
plt.show()
```



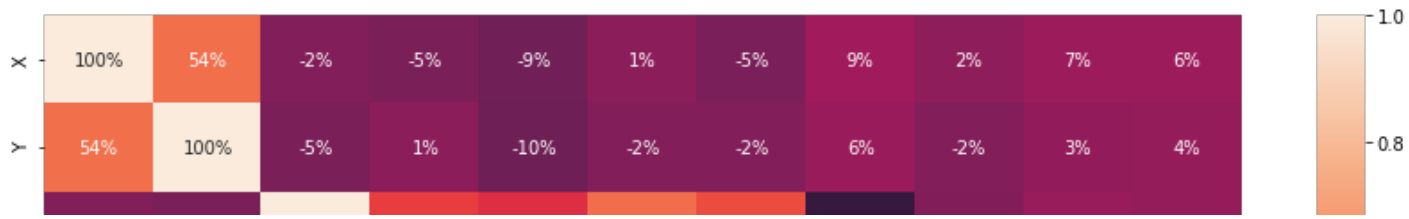
Histogram analysis gives the skewness details of the varaibles.

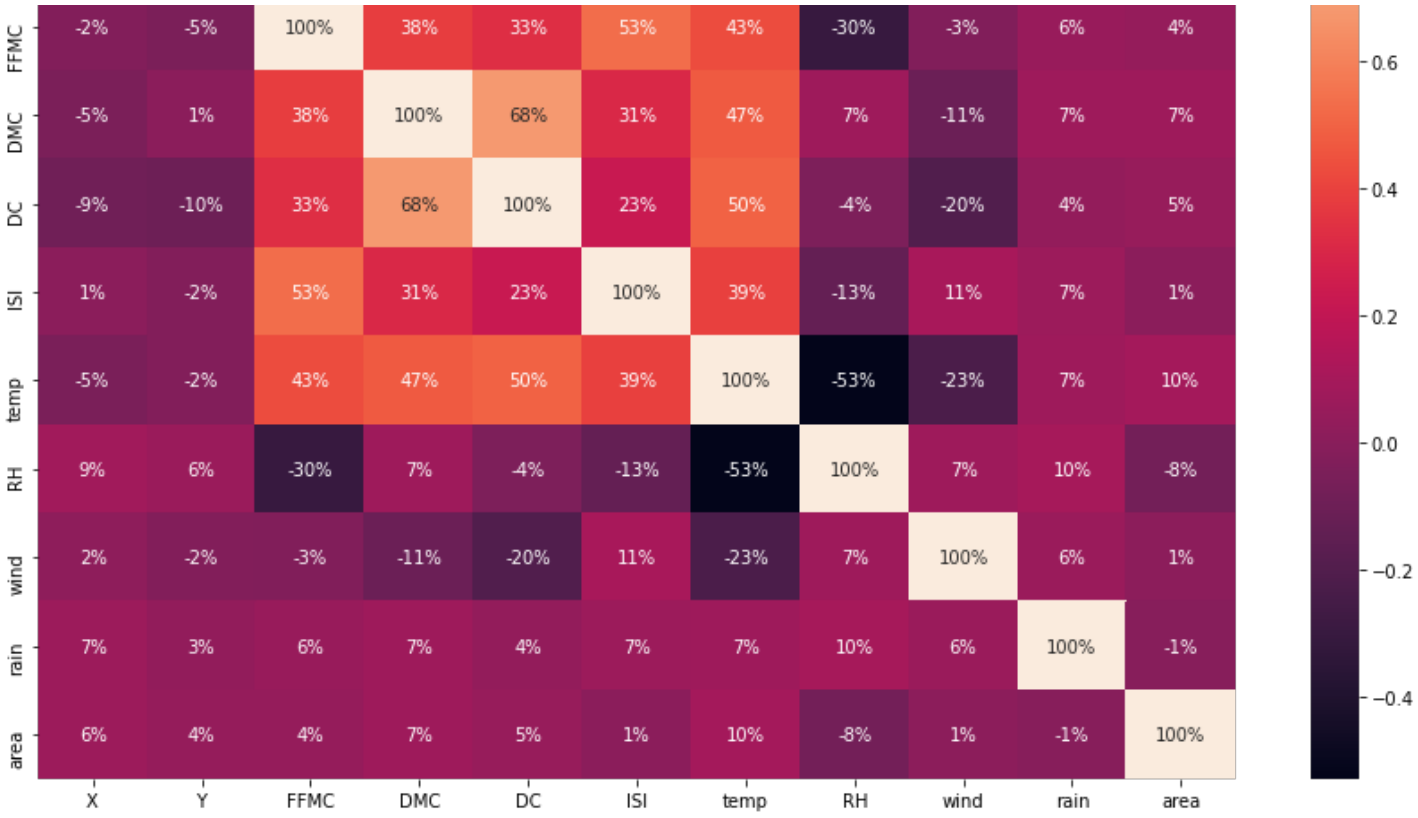
1. **We can see that area, rain and wind is completely right skewed.**
2. **FFMC is left skewed.**
3. **Variable Temp kind of shows normal distribution.**

Correlation details

In [ ]:

```
# Co-relation matrix
plt.figure(figsize = (15, 10))
sns.heatmap(df.corr(), annot = True, fmt = '.0%')
plt.show()
```





From the co-relation matrix, we can make following observations:

1. **The co-realtion matrix contains both negative and positive co-relations.**
2. **We can see that, there is 53% decrease in RH (Relative humidity) for every increase in temperature and vice-verca as from matrix.**
3. **The burnt area gives a major impact in terms of relative humidity. As RH is increased, there 8% decrease in area burnt. This means that it may not burn hot enough.**

Conclusion

1. **The forest dataset contains the area of fire burnt based on various parameters.**
2. **We have seen that the max area burnt is on September month and on Saturday.**
3. **We see that as the area burnt is more when there is no rain.**
4. **We observe that the max area burnt is when the wind is of 4.0 km/hr and Relative humidity of 27 and temperature of 25.1 degc.**
5. **The variable month and day has to be converted to Categorical variable so that the dataset will be ready for ML model.**