Data pre-processing for k-means clustering

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Advantages of k-means clustering

- One of the most popular unsupervised learning method
- Simple and fast
- Works well*

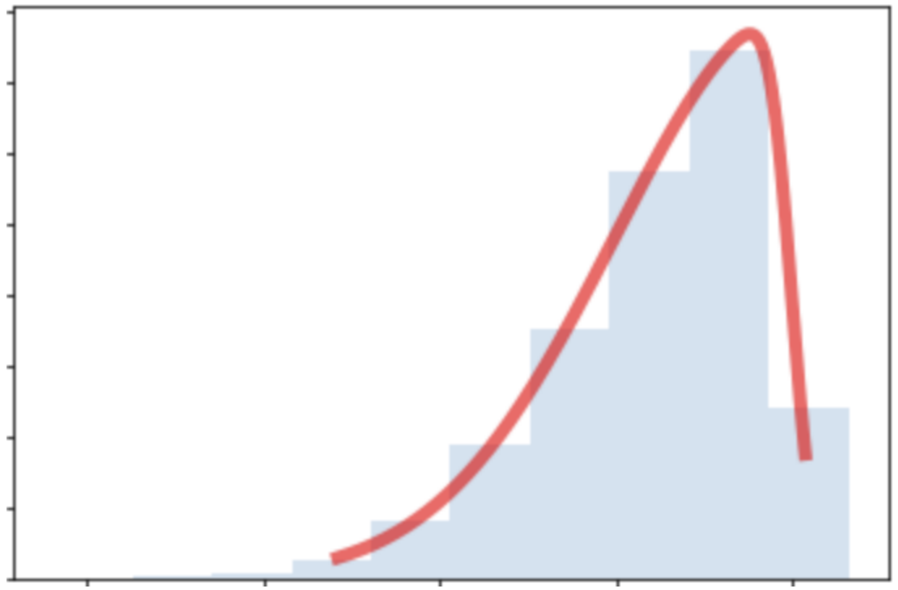
** with certain assumptions about the data*

Key k-means assumptions

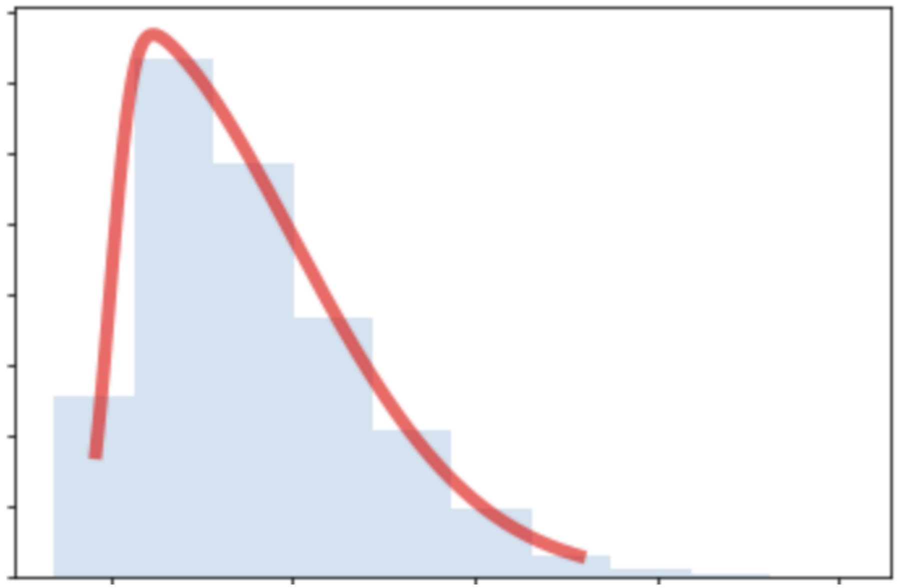
- Symmetric distribution of variables (not skewed)
- Variables with same average values
- Variables with same variance

Skewed variables

- Left-skewed

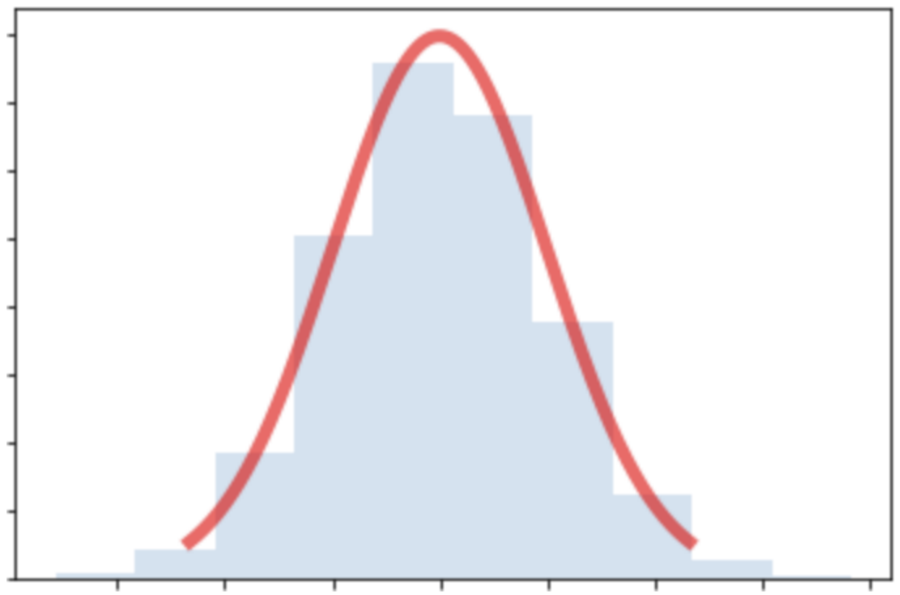


- Right-skewed



Skewed variables

- Skew removed with logarithmic transformation



Variables on the same scale

- K-means assumes equal mean
- And equal variance
- It's not the case with RFM data

```
datamart_rfm.describe()
```

	Recency	Frequency	MonetaryValue
count	3643.00000	3643.000000	3643.000000
mean	90.43563	18.714247	370.694387
std	94.44651	43.754468	1347.443451
min	1.00000	1.000000	0.650000
25%	19.00000	4.000000	58.705000
50%	51.00000	9.000000	136.370000
75%	139.00000	21.000000	334.350000
max	365.00000	1497.000000	48060.350000

Let's review the concepts

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Managing skewed variables

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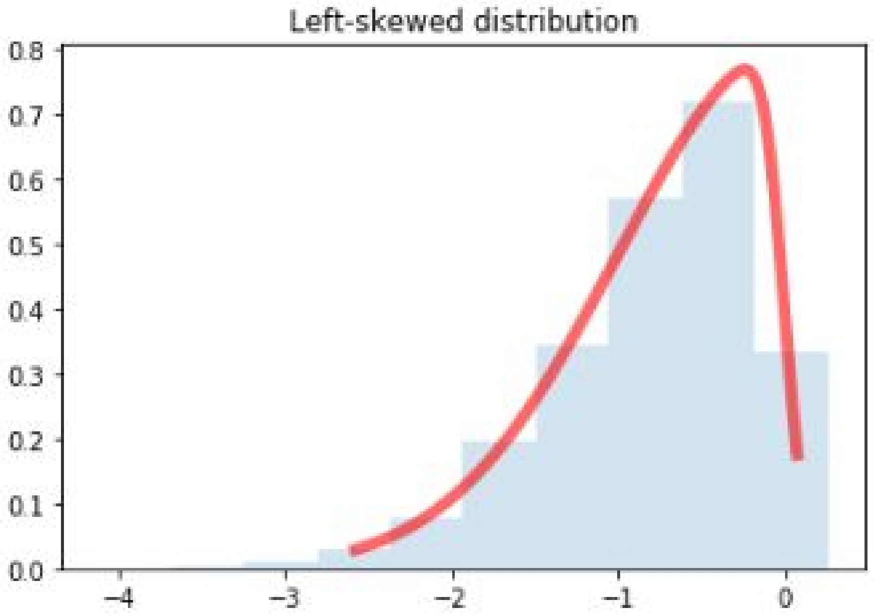
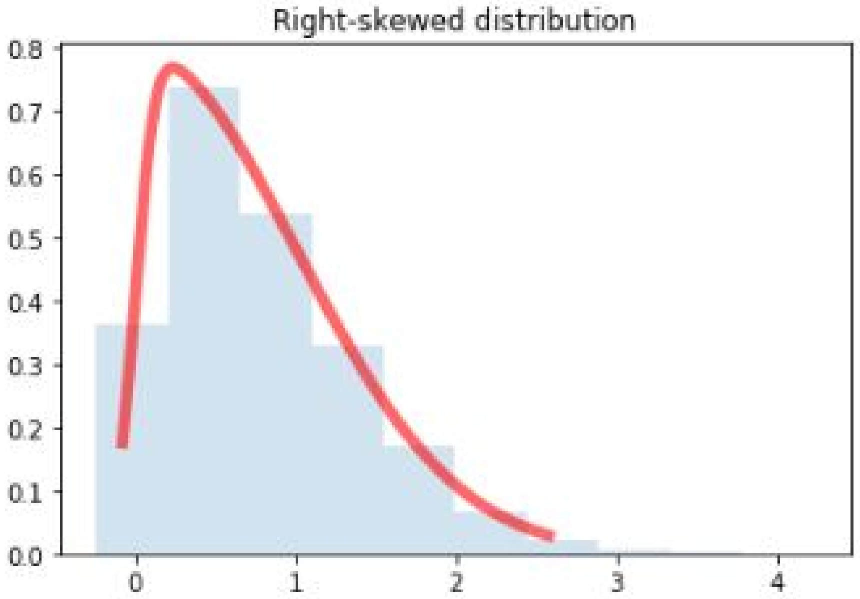
Identifying skewness

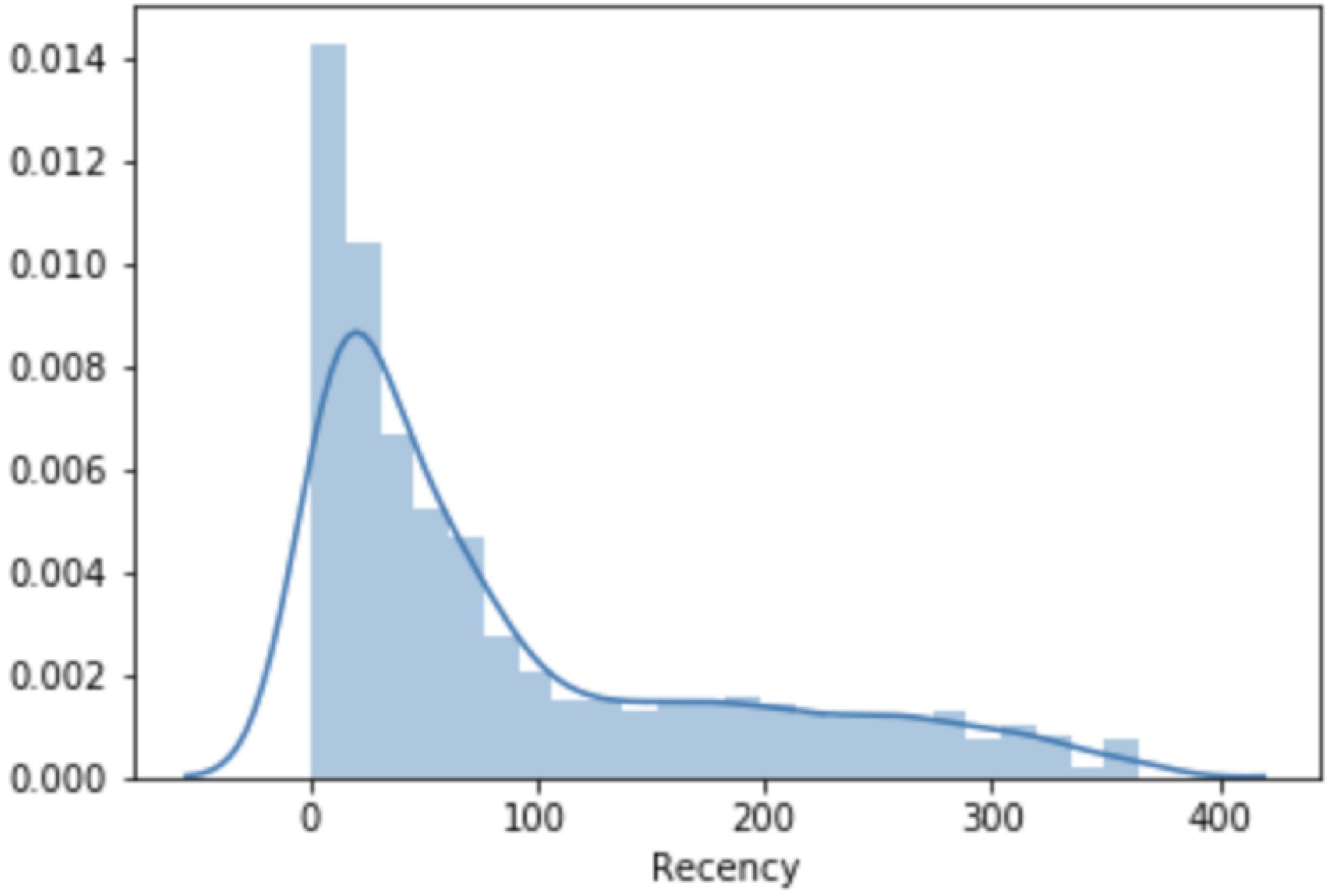
- Visual analysis of the distribution
- If it has a tail - it's skewed





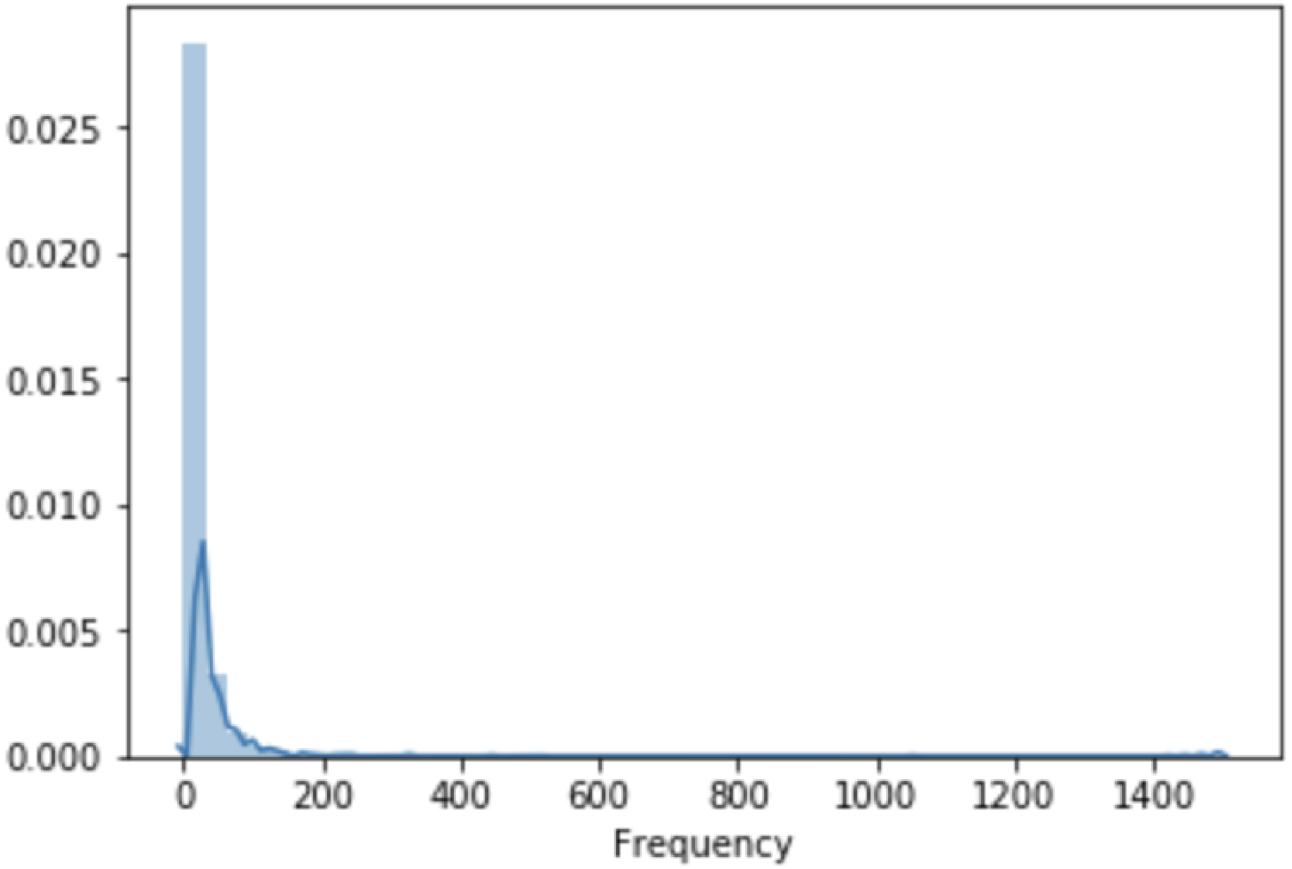
Exploring distribution of recency

```
sns.distplot(datamart['Recency'])
plt.show()
```



Exploring distribution of frequency

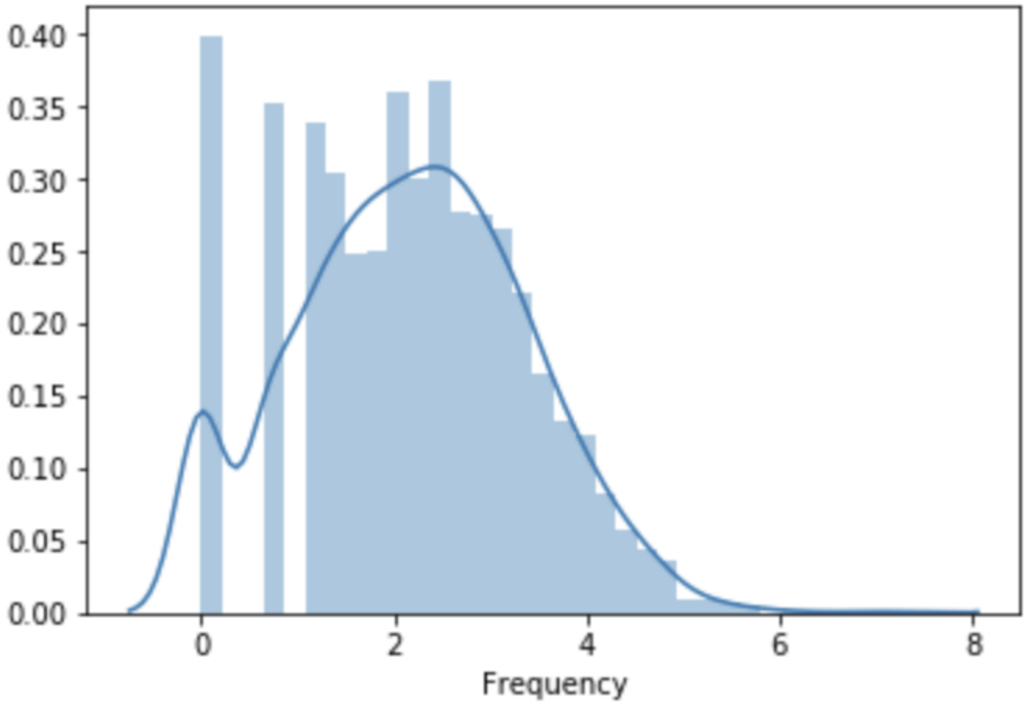
```
sns.distplot(datamart['Frequency'])
plt.show()
```



Data transformations to manage skewness

- Logarithmic transformation (positive values only)

```
import numpy as np
frequency_log= np.log(datamart['Frequency'])
sns.distplot(frequency_log)
plt.show()
```



Dealing with negative values

- Adding a constant before log transformation
- Cube root transformation

Let's practice how to identify and manage skewed variables!

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Centering and scaling variables

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Identifying an issue

- Analyze key statistics of the dataset
- Compare mean and standard deviation

```
datamart_rfm.describe()
```

	Recency	Frequency	MonetaryValue
count	3643.00000	3643.000000	3643.000000
mean	90.43563	18.714247	370.694387
std	94.44651	43.754468	1347.443451
min	1.00000	1.000000	0.650000
25%	19.00000	4.000000	58.705000
50%	51.00000	9.000000	136.370000
75%	139.00000	21.000000	334.350000
max	365.00000	1497.000000	48060.350000

Centering variables with different means

- K-means works well on variables with the same mean
- Centering variables is done by subtracting average value from each observation

```
datamart_centered = datamart_rfm - datamart_rfm.mean()
datamart_centered.describe().round(2)
```

	Recency	Frequency	MonetaryValue
count	3643.00	3643.00	3643.00
mean	0.00	-0.00	0.00
std	94.45	43.75	1347.44
min	-89.44	-17.71	-370.04
25%	-71.44	-14.71	-311.99
50%	-39.44	-9.71	-234.32
75%	48.56	2.29	-36.34
max	274.56	1478.29	47689.66

Scaling variables with different variance

- K-means works better on variables with the same variance / standard deviation
- Scaling variables is done by dividing them by standard deviation of each

```
datamart_scaled = datamart_rfm / datamart_rfm.std()
datamart_scaled.describe().round(2)
```

	Recency	Frequency	MonetaryValue
count	3643.00	3643.00	3643.00
mean	0.96	0.43	0.28
std	1.00	1.00	1.00
min	0.01	0.02	0.00
25%	0.20	0.09	0.04
50%	0.54	0.21	0.10
75%	1.47	0.48	0.25
max	3.86	34.21	35.67

Combining centering and scaling

- Subtract mean and divide by standard deviation manually
- Or use a scaler from `scikit-learn` library (returns `numpy.ndarray` object)

```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
scaler.fit(datamart_rfm)
datamart_normalized = scaler.transform(datamart_rfm)
print('mean: ', datamart_normalized.mean(axis=0).round(2))
print('std: ', datamart_normalized.std(axis=0).round(2))
```

```
mean:  [-0. -0.  0.]
std:  [1. 1. 1.]
```

Test different approaches by yourself!

Sequence of structuring pre-processing steps

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Why the sequence matters?

- Log transformation only works with positive data
- Normalization forces data to have negative values and `log` will not work

Sequence

1. Unskew the data - log transformation
2. Standardize to the same average values
3. Scale to the same standard deviation
4. Store as a separate array to be used for clustering

Coding the sequence

```
# Unskew the data
import numpy as np
datamart_log = np.log(datamart_rfm)

# Normalize the variables
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
scaler.fit(datamart_log)

# Store for clustering
datamart_normalized = scaler.transform(datamart_log)
```

Practice on RFM data!

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