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Distribution Plots

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Distribution plots display a single continuous feature and help visualize properties such as deviation and average values.

3 main distribution plot types:

- ○ Rug Plot
- ○ Histogram
- ○ KDE Plot

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Let’s explore the distribution of employee salaries.

- One way is a rug plot which is the simplest distribution plot and merely adds a dash or tick line for every single value.
- The y-axis does not really have a meaning.

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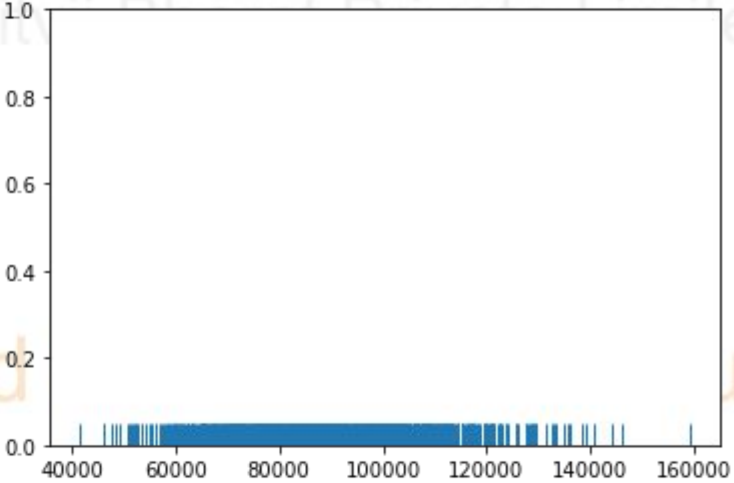
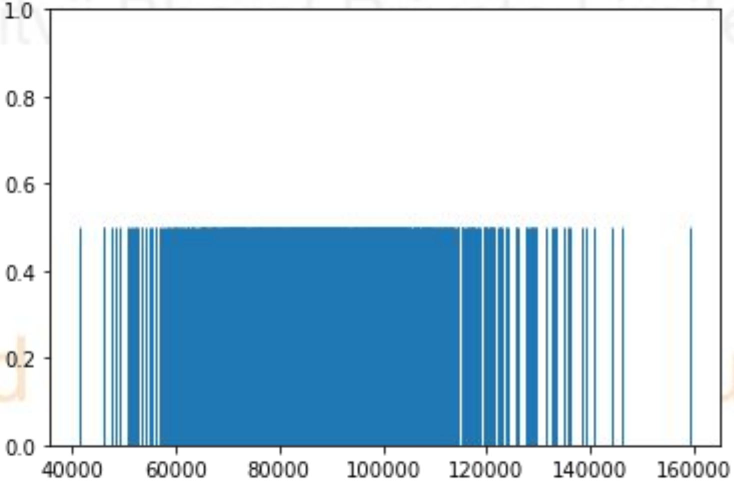
1. Adds a tick for every salary value
2. Optionally adjust height of ticks
3. Y-axis not interpretable



1. Highest salary near $160,000
2. Many salaries between $60k - $120k

Many ticks could be right on top of eachother, we can't tell!If we count how many ticks there are per various x-ranges, we can create a histogram.



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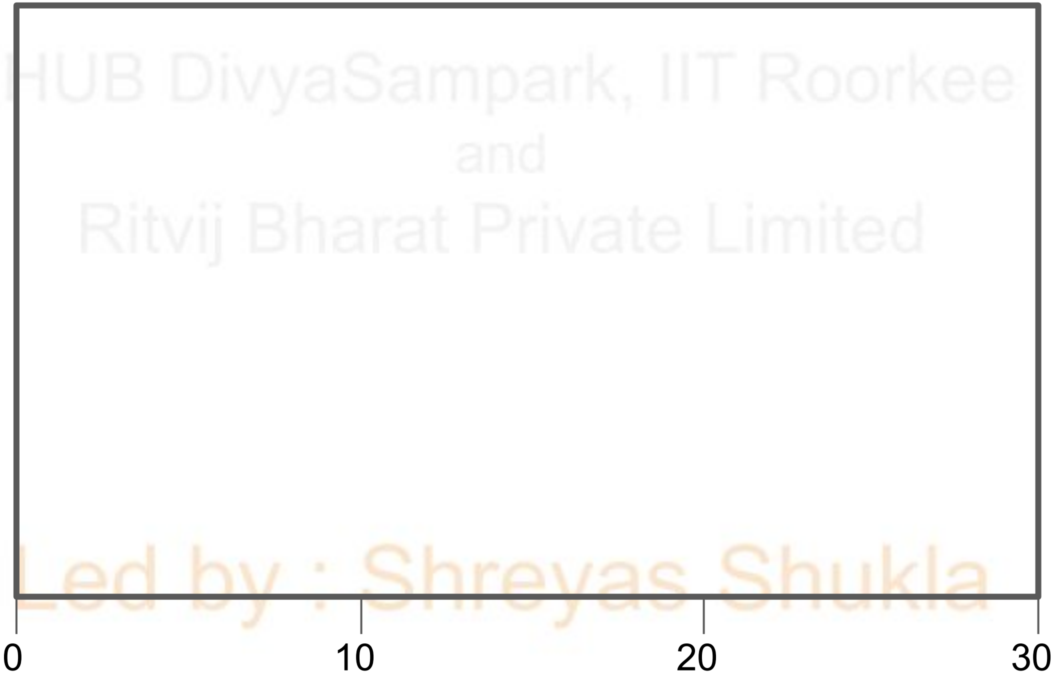
Let’s explore a simple example



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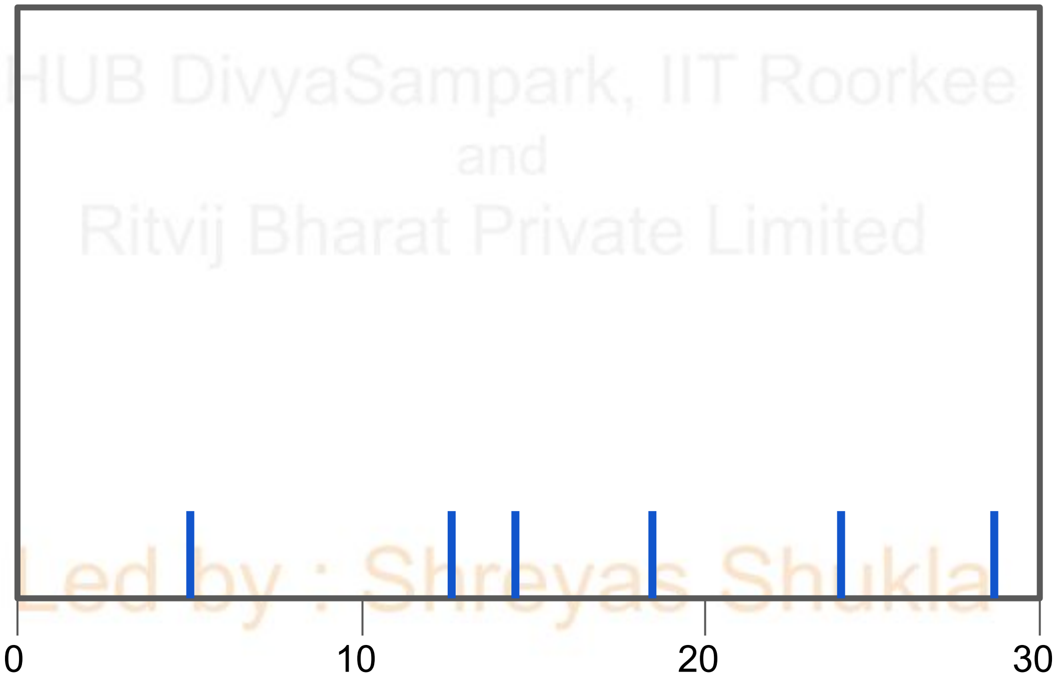
We place the rug plot ticks



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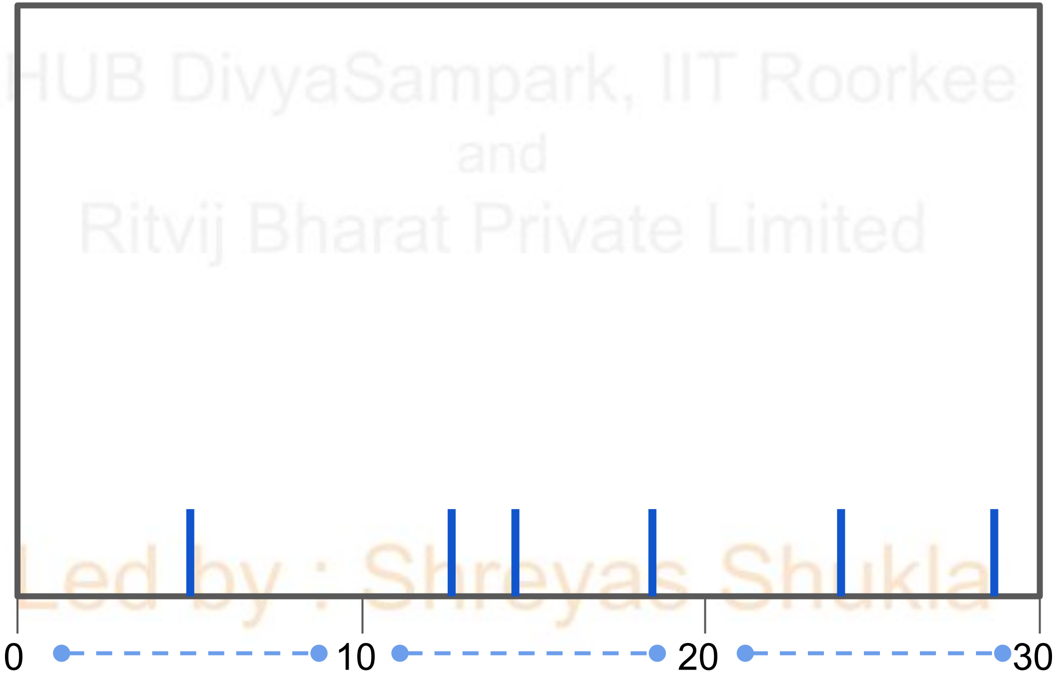
Choose a number of “bins”, we’ll pick 3



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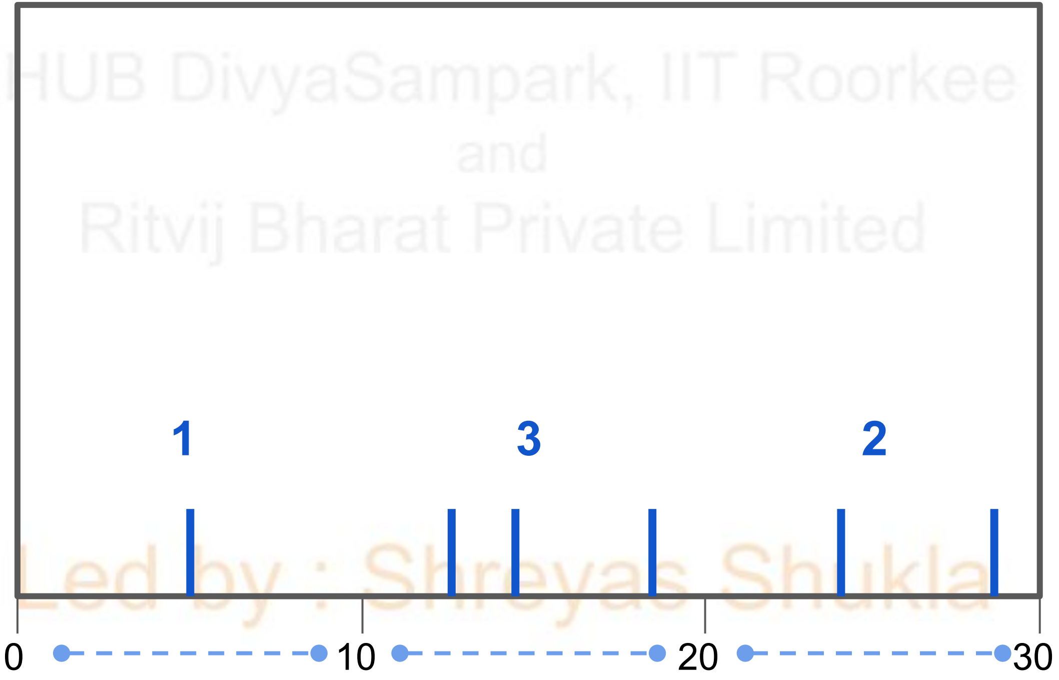
Count ticks per bin



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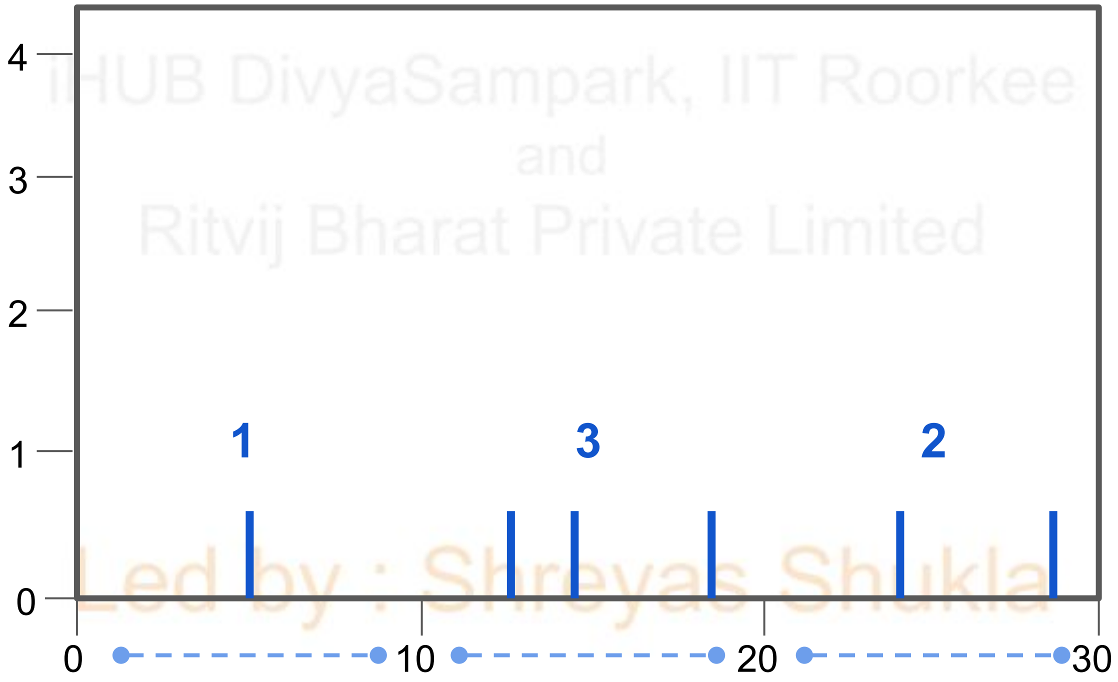
Create a bar as high as count



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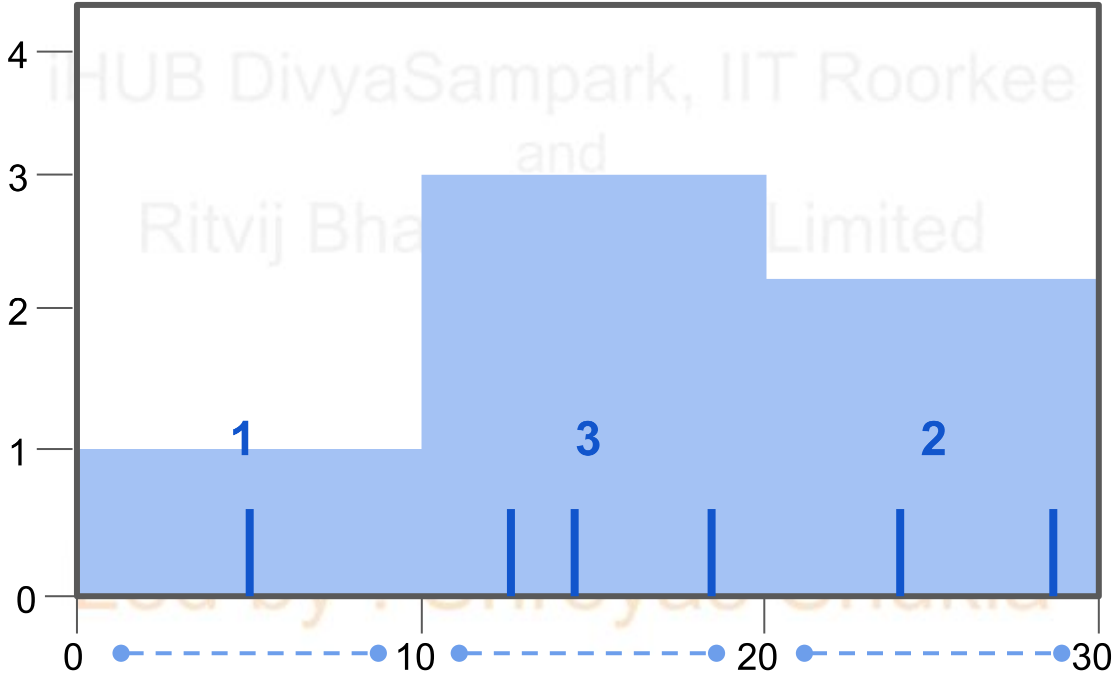
Create a bar as high as count



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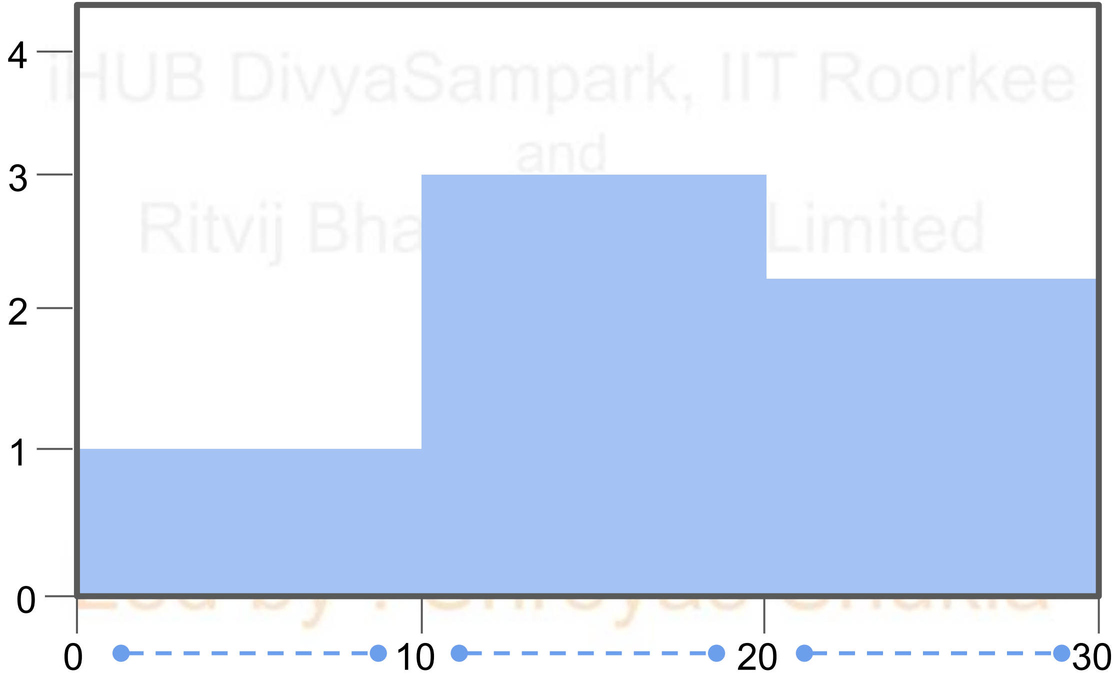
Create a bar as high as count



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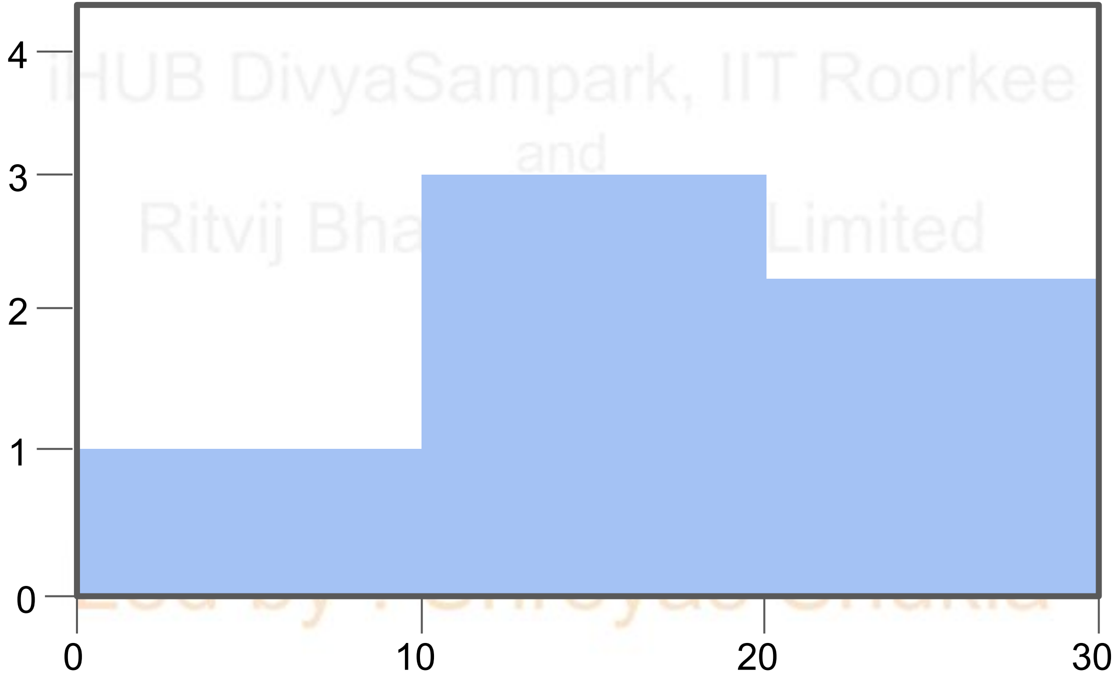
Histogram is complete



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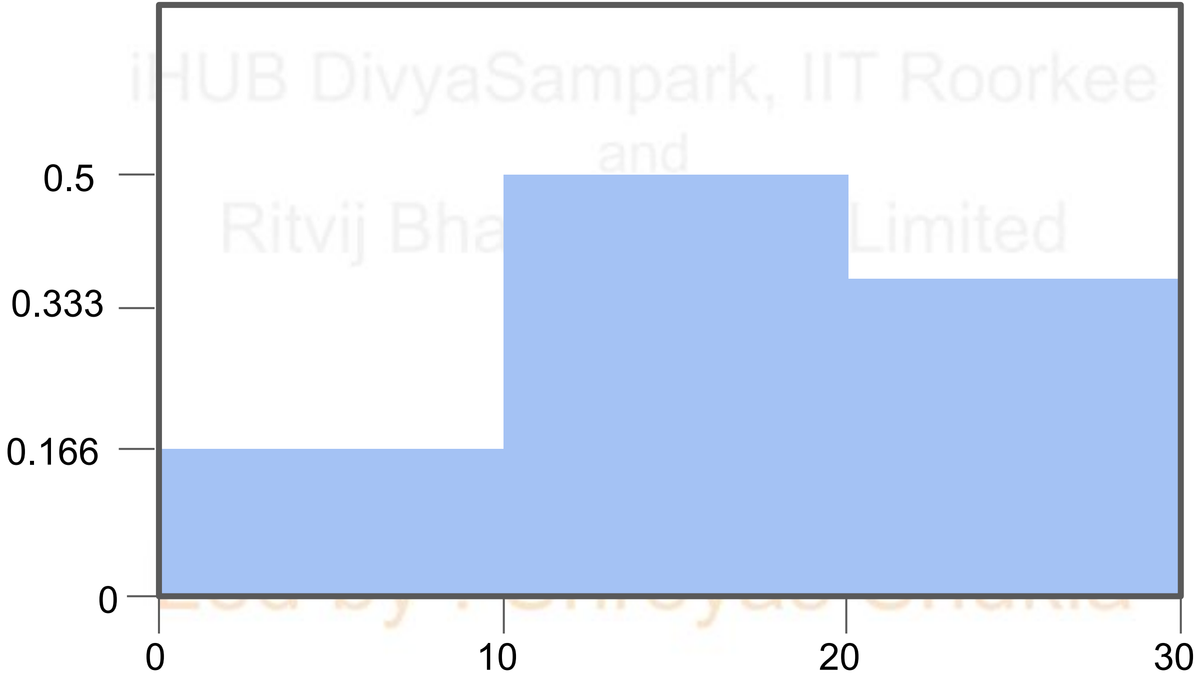
Y-axis can also be normalized as percent



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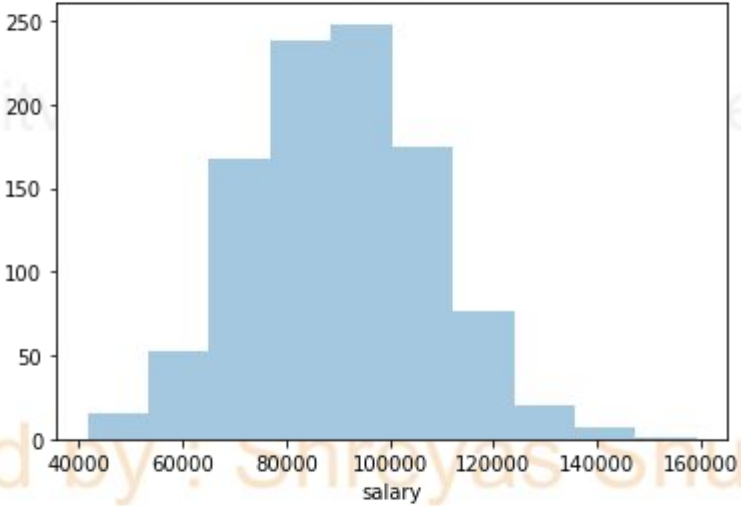
Changing number of bins shows more detail instead of general trends.



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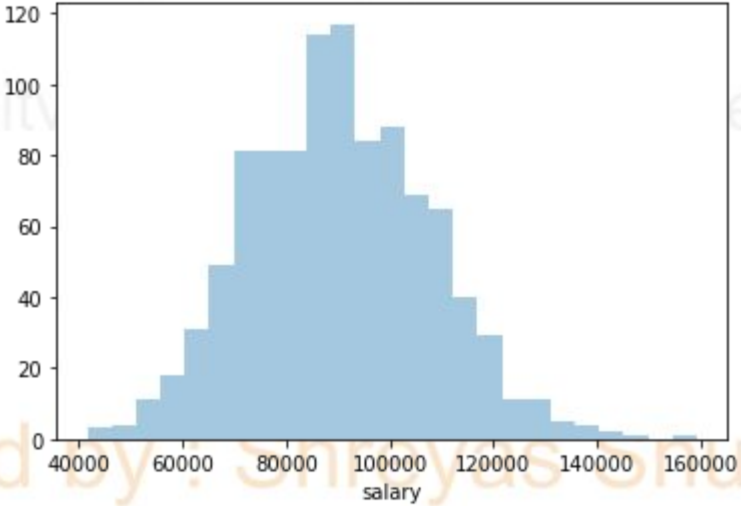

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Changing number of bins shows more detail instead of general trends.

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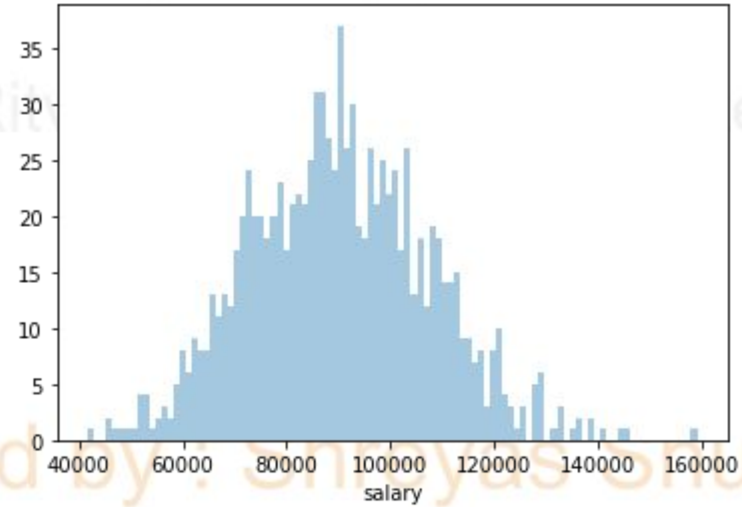

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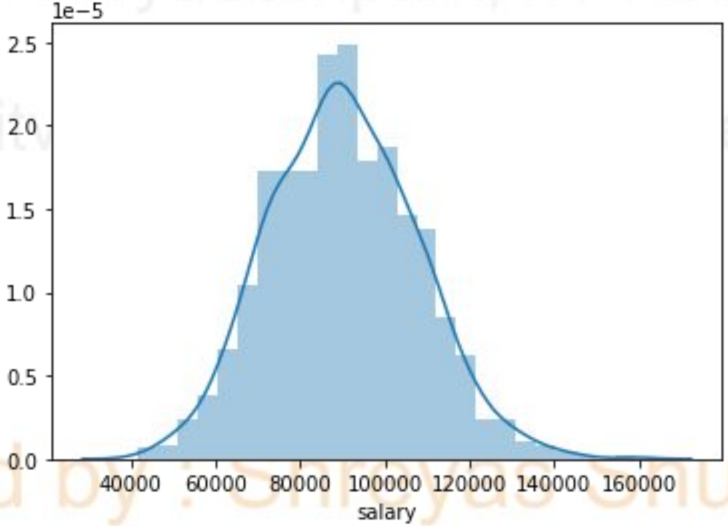
Seaborn also allows us to add on a KDE plot curve on top of a histogram.



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Let’s explore what a KDE plot is and how it is constructed.

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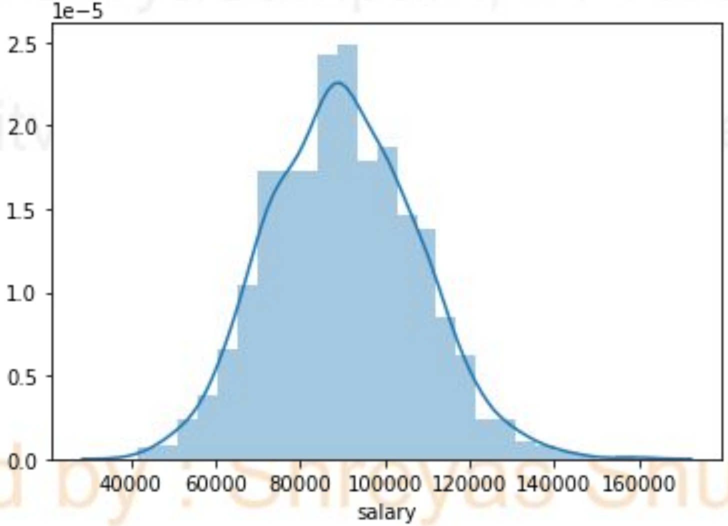

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Kernel Density Estimation (KDE) is a method of **estimating** a probability density function of a random variable.

In simpler terms, it is a way of estimating a continuous probability curve for a finite data sample.

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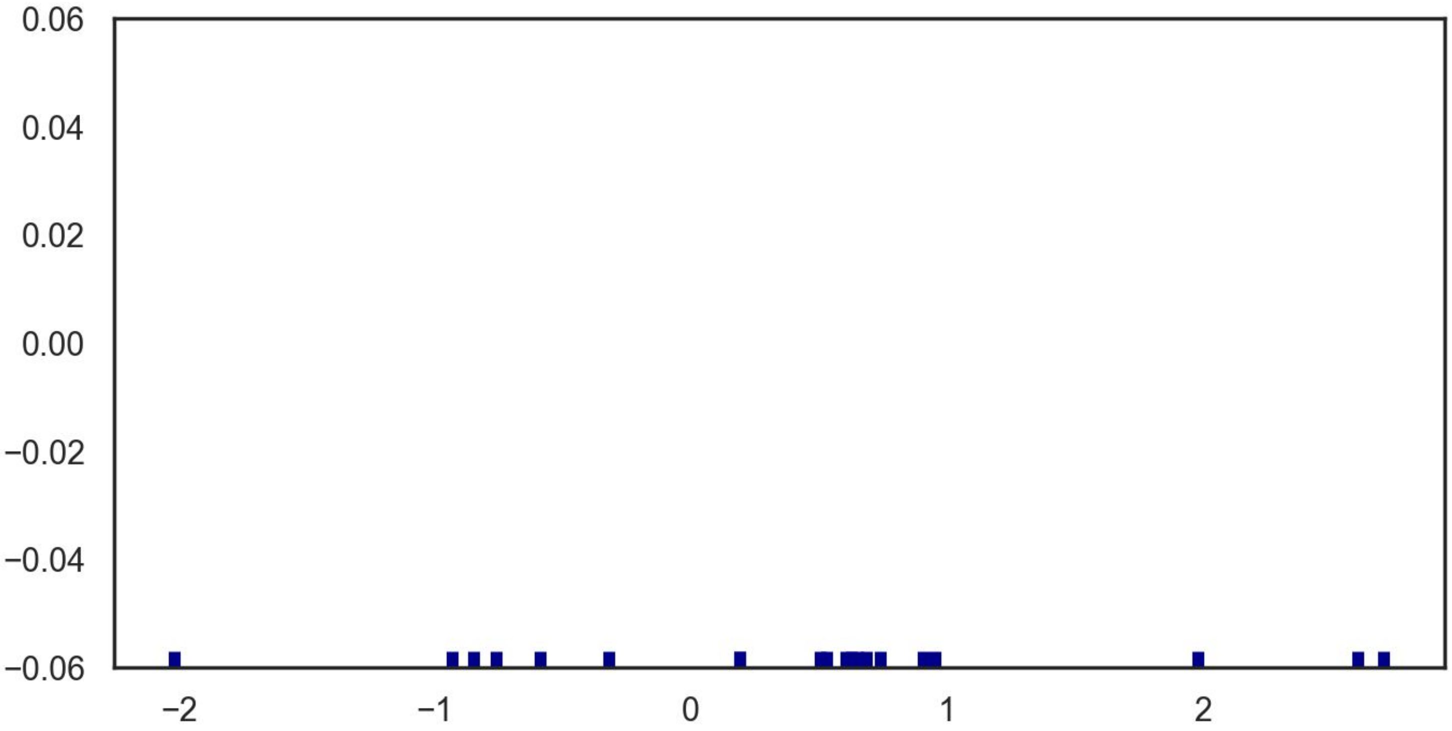
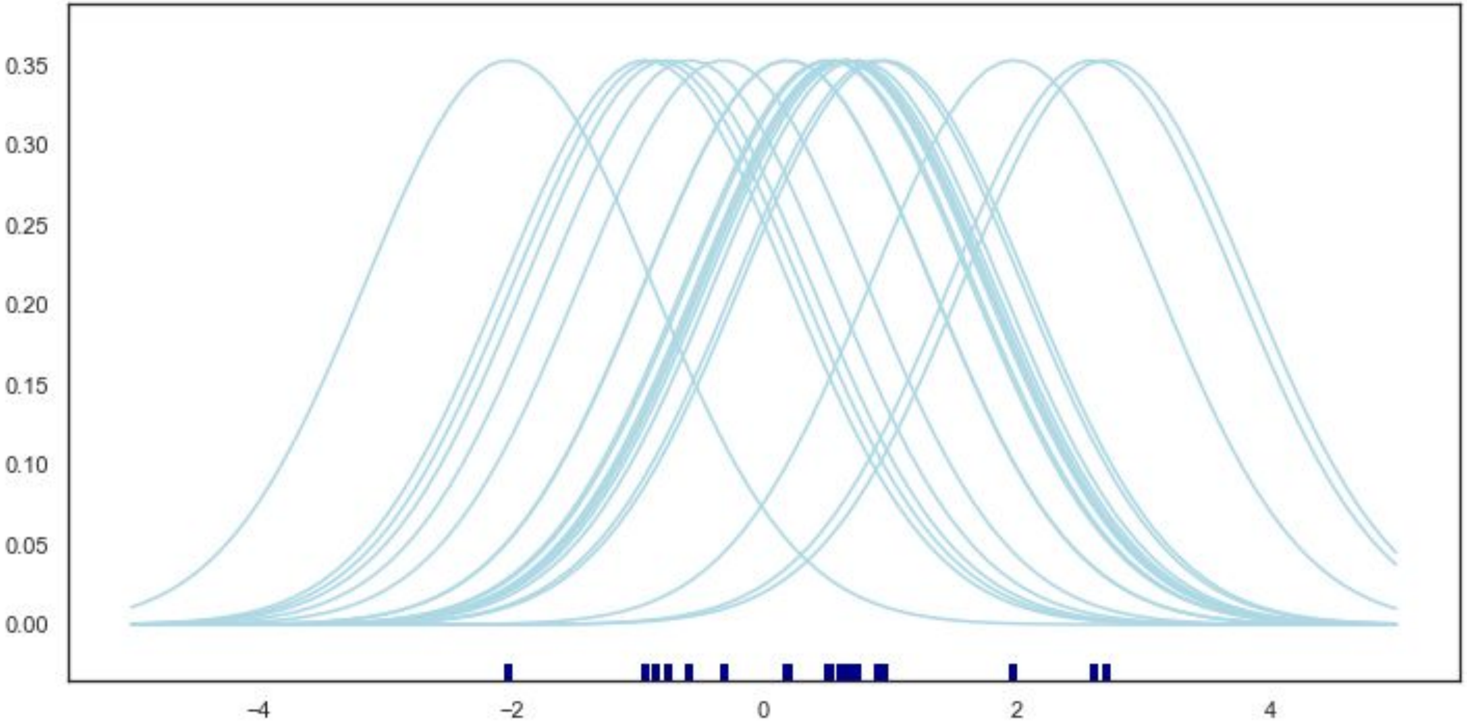
KDE plots are best understood by visualizing their “construction”.

Let’s start with a rug plot….


0.06
0.04
0.02
0.00
−0.02
−0.04
−0.06
−2
−1
0
1
2


0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
−4
−2
0
2
4

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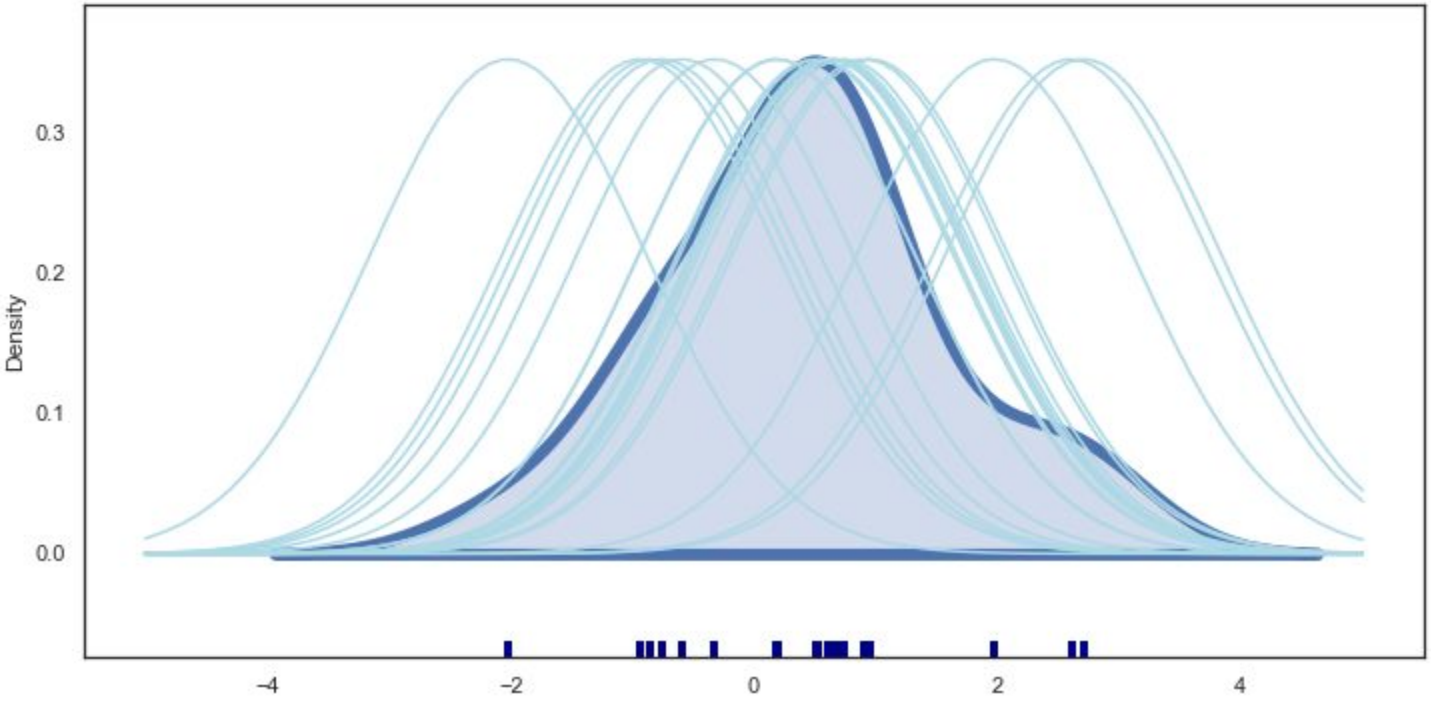

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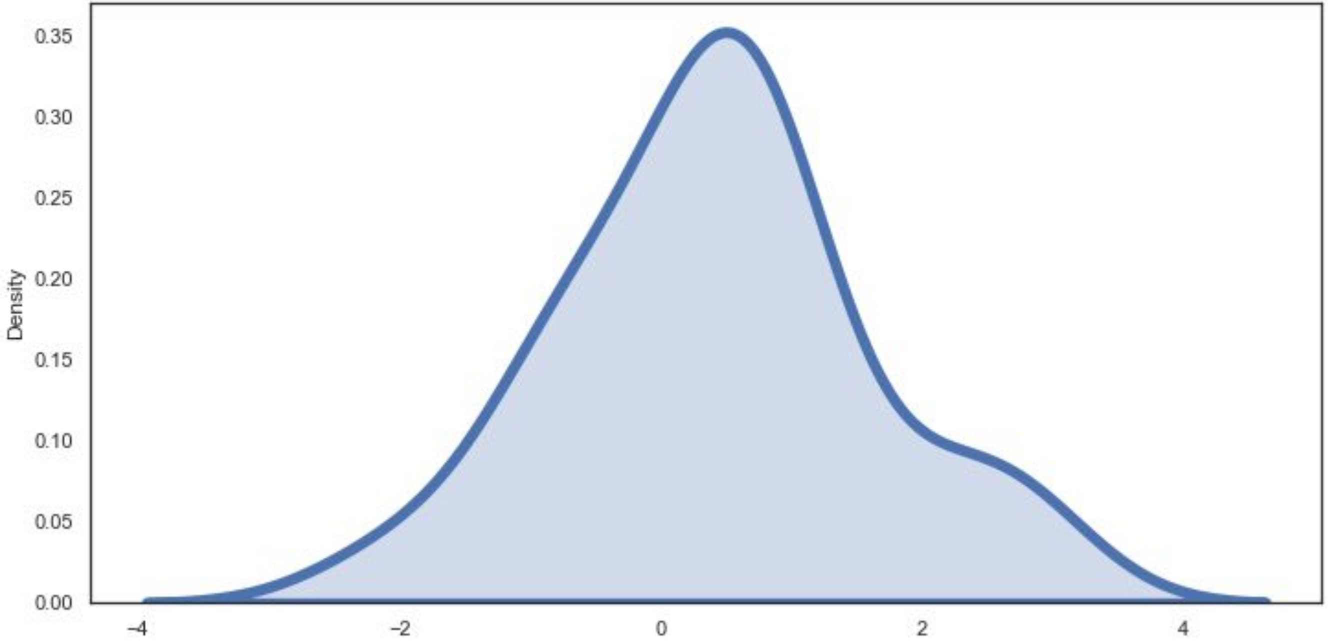

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You can change the kernel and bandwidth used which can make your KDE show more or less of the variance contained in the data.

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Categorical Plots

Statistical Estimation within Categories
Part One: Understanding the Plots

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The categorical plots display a statistical metrics **per** a category.

- For example mean value per category or a count of the number of rows **per** category.
- It is the visualization equivalent of a groupby() call.

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Two main types of plots for this are:

- countplot()
  - Counts number of rows per category.
- barplot()
  - General form of displaying any chosen metric per category.

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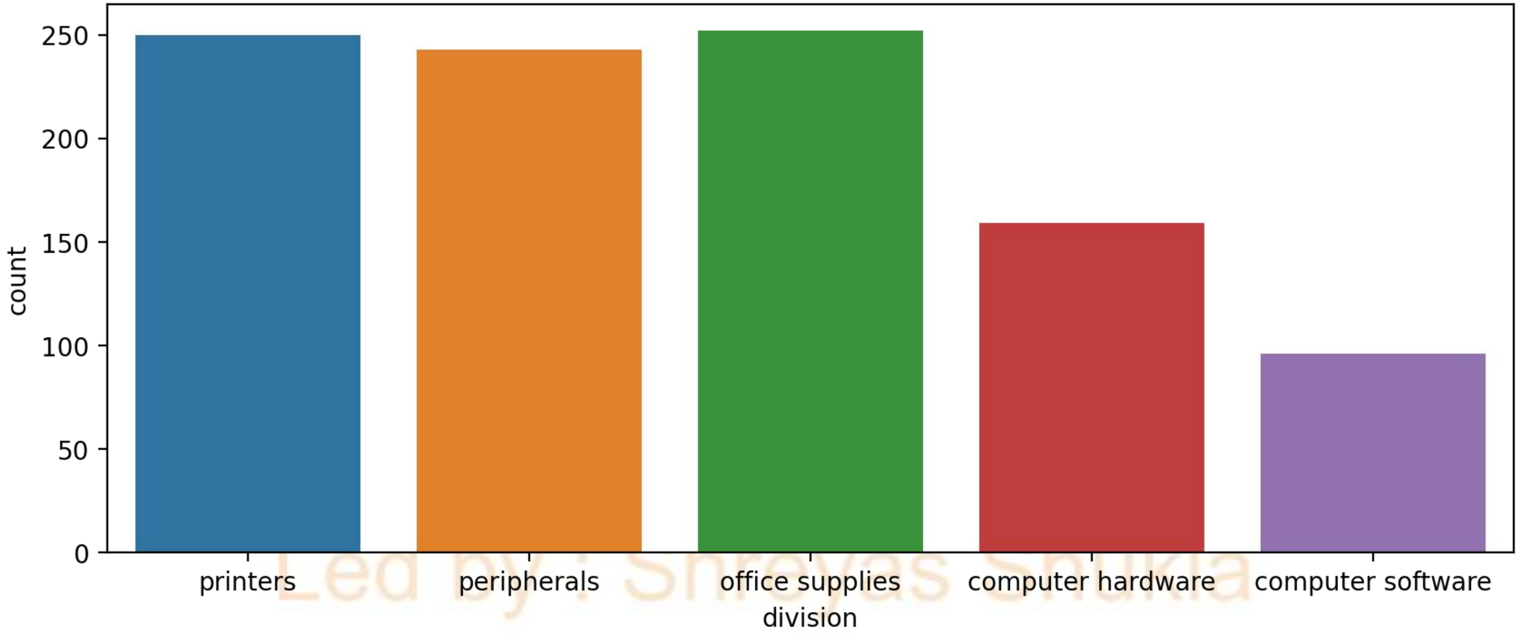
Countplot for corporate divisions



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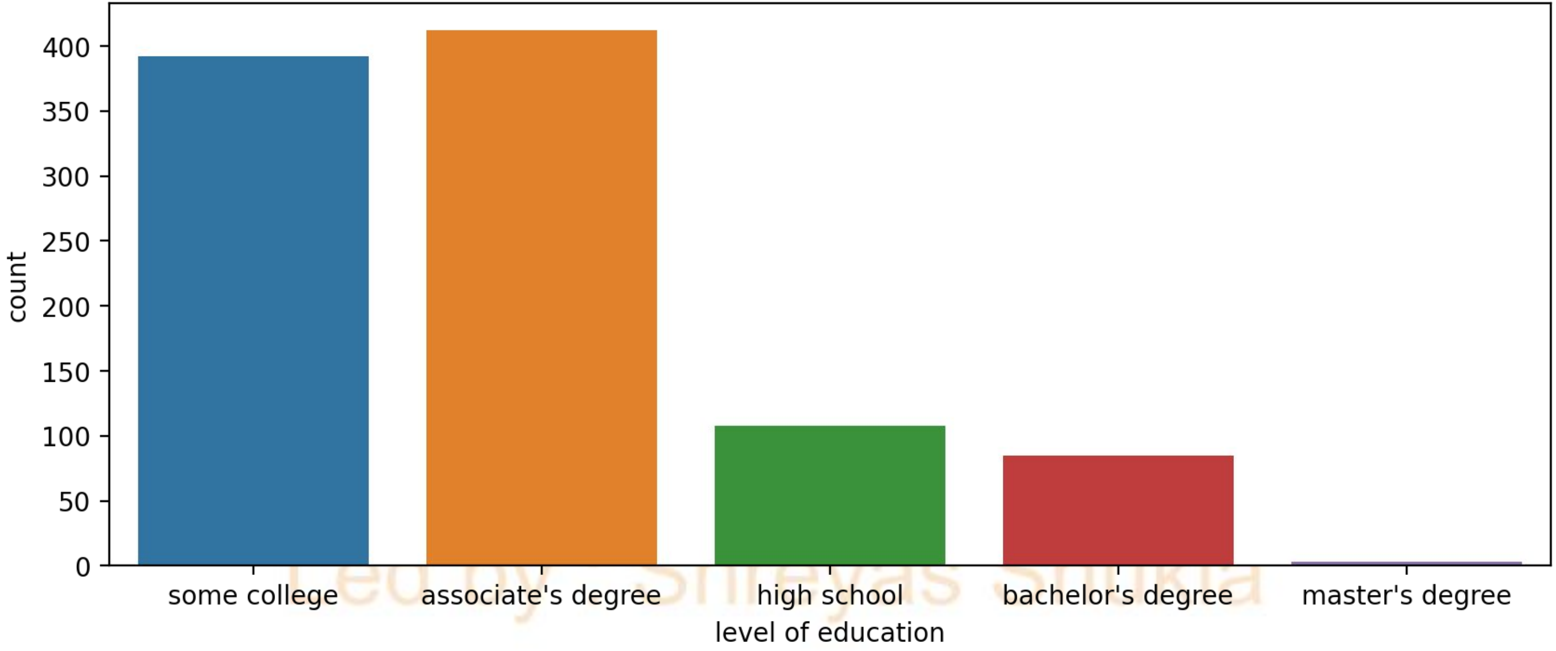
Countplot for education level



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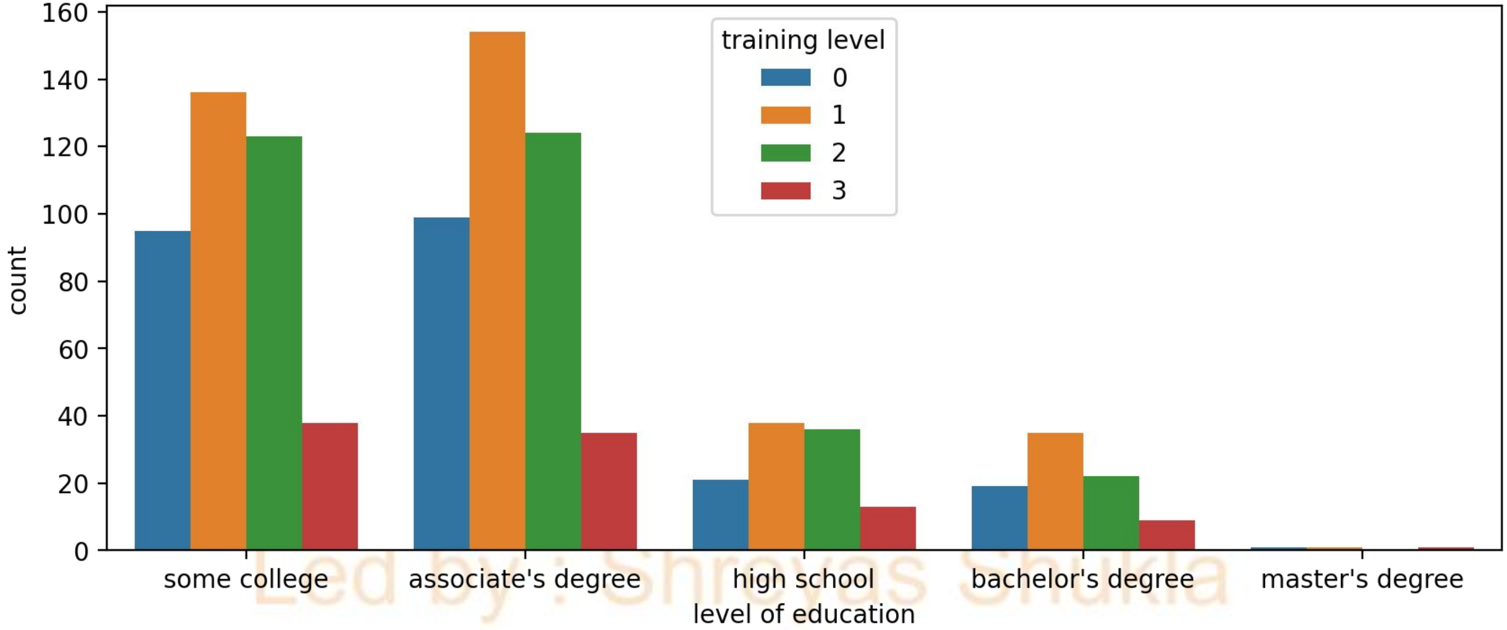
Countplot with additional hue separation



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The barplot is the general form that allows you to choose any measure or estimator for the y axis.

We could plot the mean value and standard deviation per category instead.

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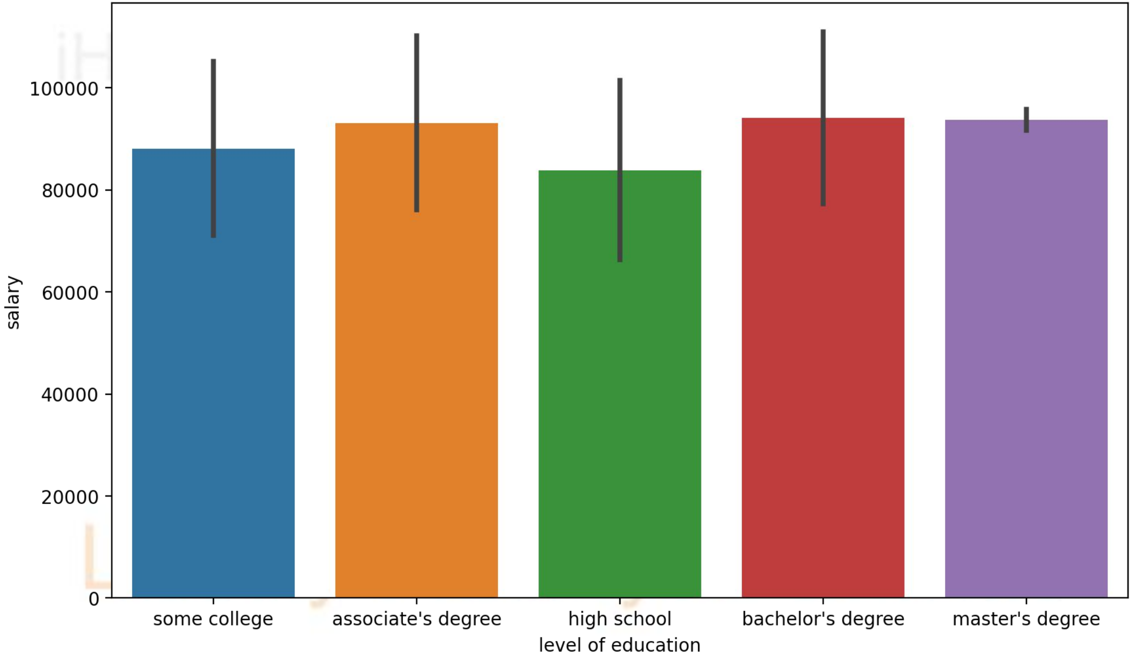
Caution!

- Be very careful with these plots, since the bar is filled and continuous, a viewer may interpret continuity along the y-axis which may be incorrect!
- Always make sure to add additional labeling and explanation for these plots!

Barplot showing mean and SD bar



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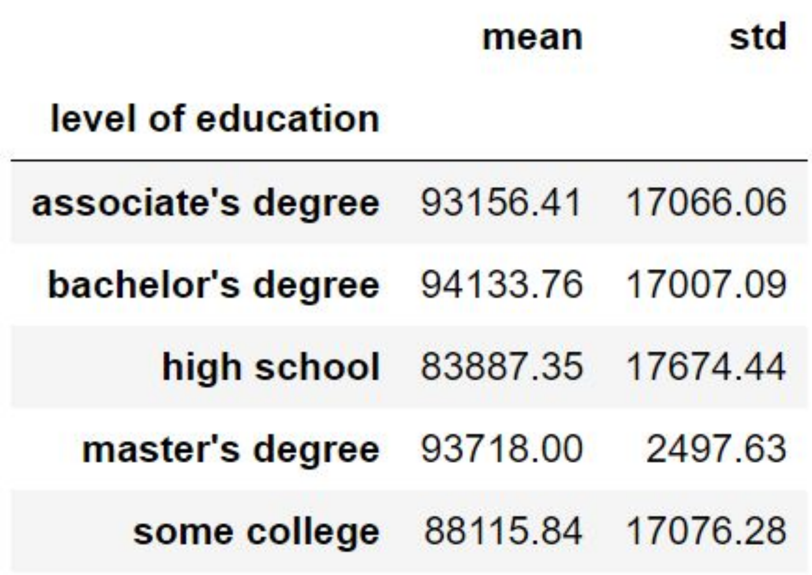
A simple table is probably better.



	mean	std
level of education		
associate's degree	93156.41	17066.06
bachelor's degree	94133.76	17007.09
high school	83887.35	17674.44
master's degree	93718.00	2497.63
some college	88115.84	17076.28

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Let’s explore coding out these plots with seaborn!

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Categorical Plots

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We’ve explored distribution plots for a single feature, but what if we want to compare distributions across categories?

For example, instead of the distribution of everyone’s salary, we can compare the distributions of salaries **per** level of education.

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We will first separate out each category, then create the distribution visualization.

Let’s explore what plot types we have available….

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Distribution within Categories

- ○ Boxplot
- ○ Violinplot
- ○ Swarmplot

Let’s explore understanding these plots on the previous salary dataset.

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The Boxplot displays the distribution of a continuous variable. It does this through the use of quartiles.

Quartiles separate out the data into 4 equal number of data points :

- ○ 25% of data points are in bottom quartile.
- ○ 50th percentile (Q2) is the median.

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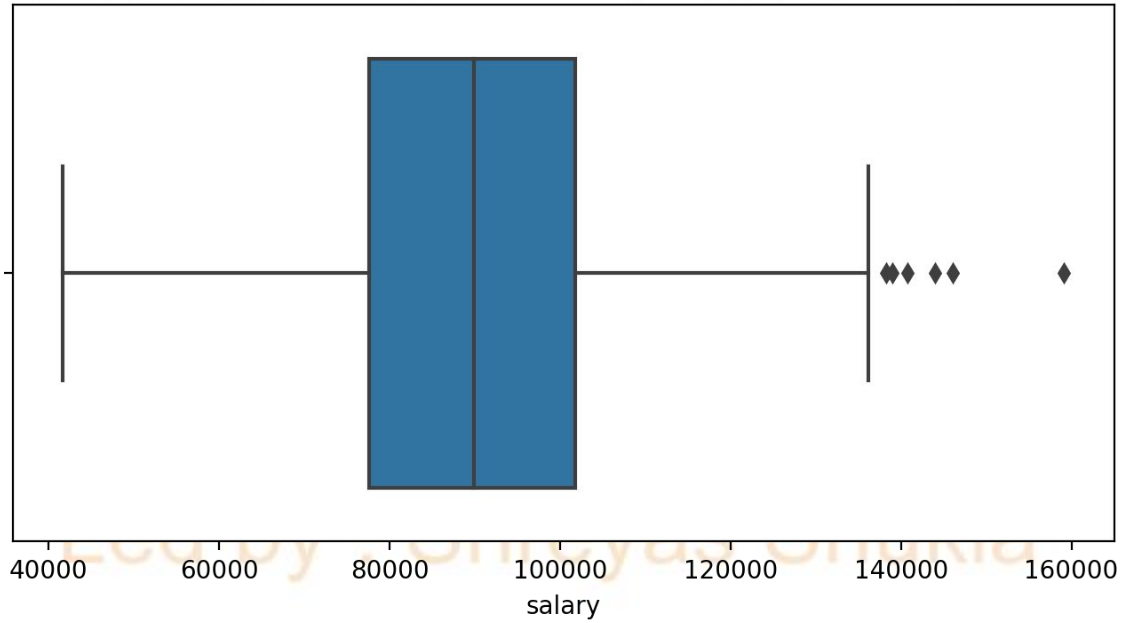
Boxplot on single feature:



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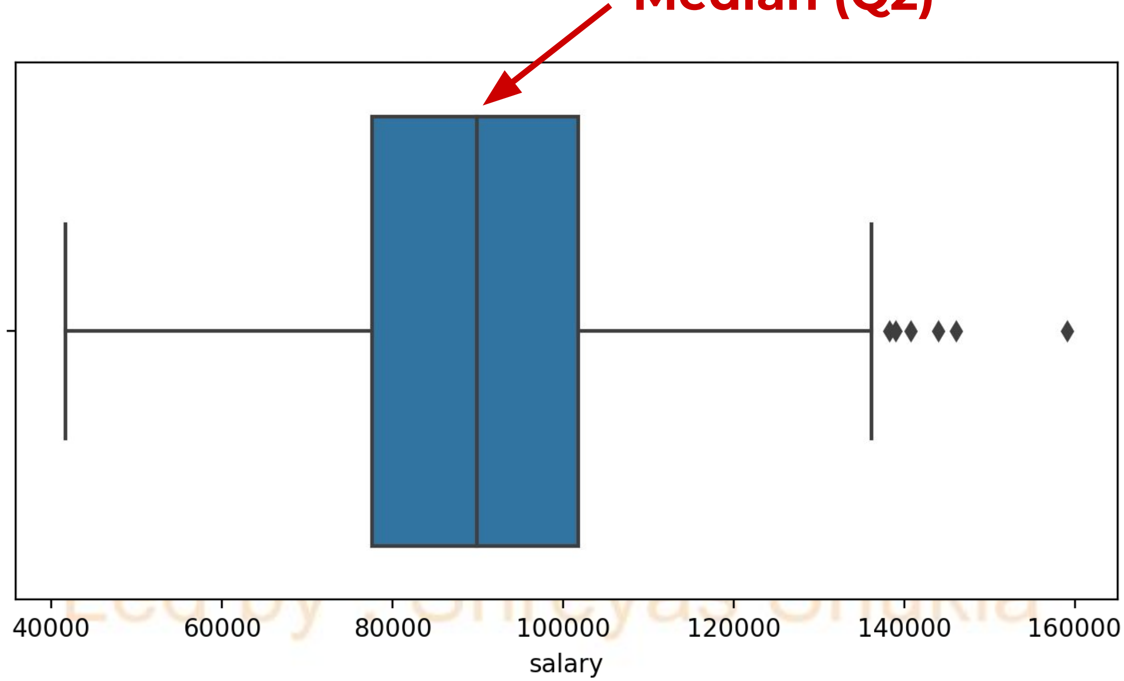
Median is 50th percentile. Median splits data in half



Median (Q2)

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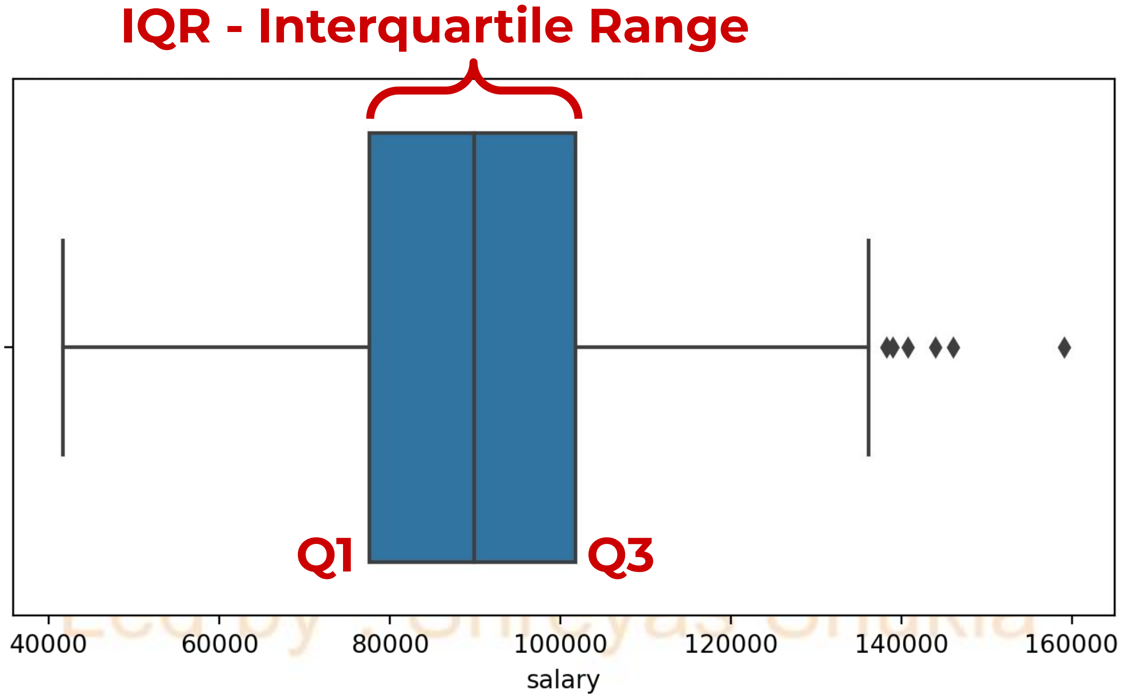
- IQR defines the box width
- 50% of all data points are inside the box



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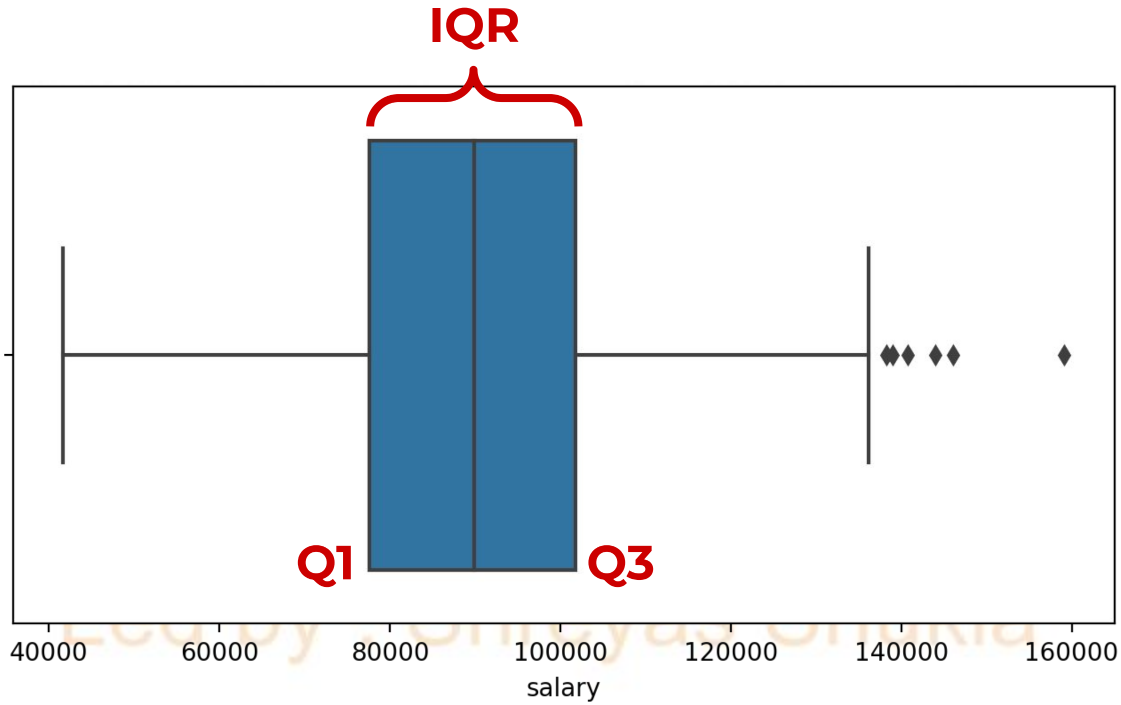
Q1 is the 25th percentile below which are 25% of data points



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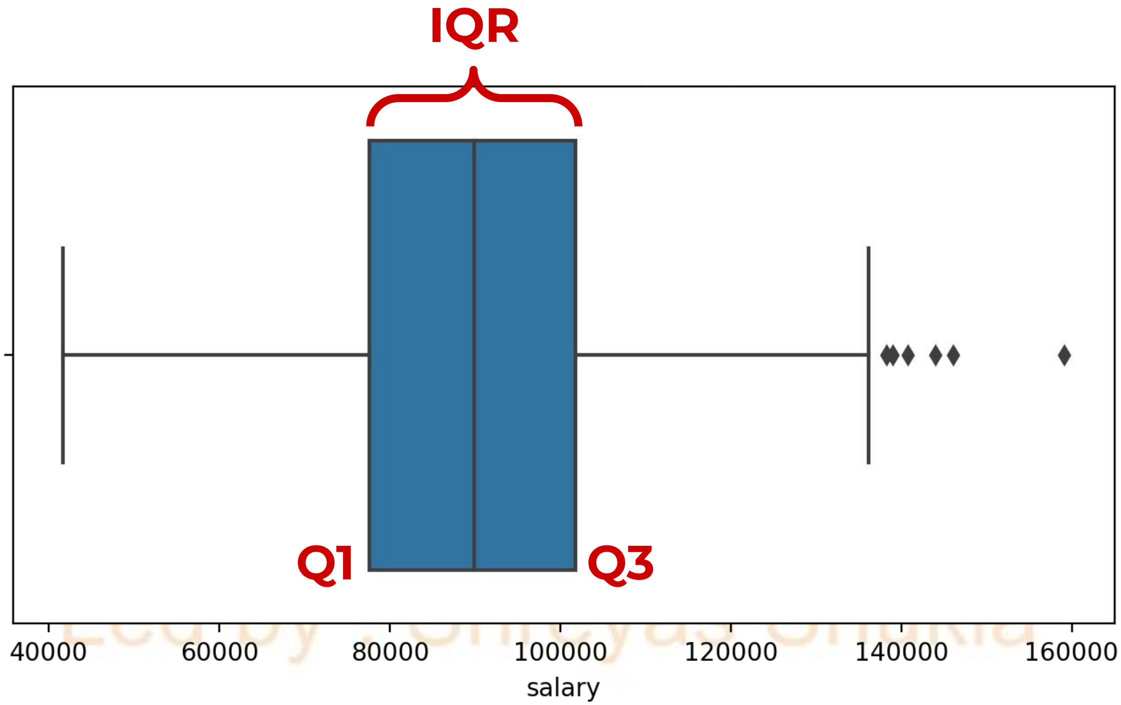
Q3 is the 75th percentile. 25% of all points are above Q3



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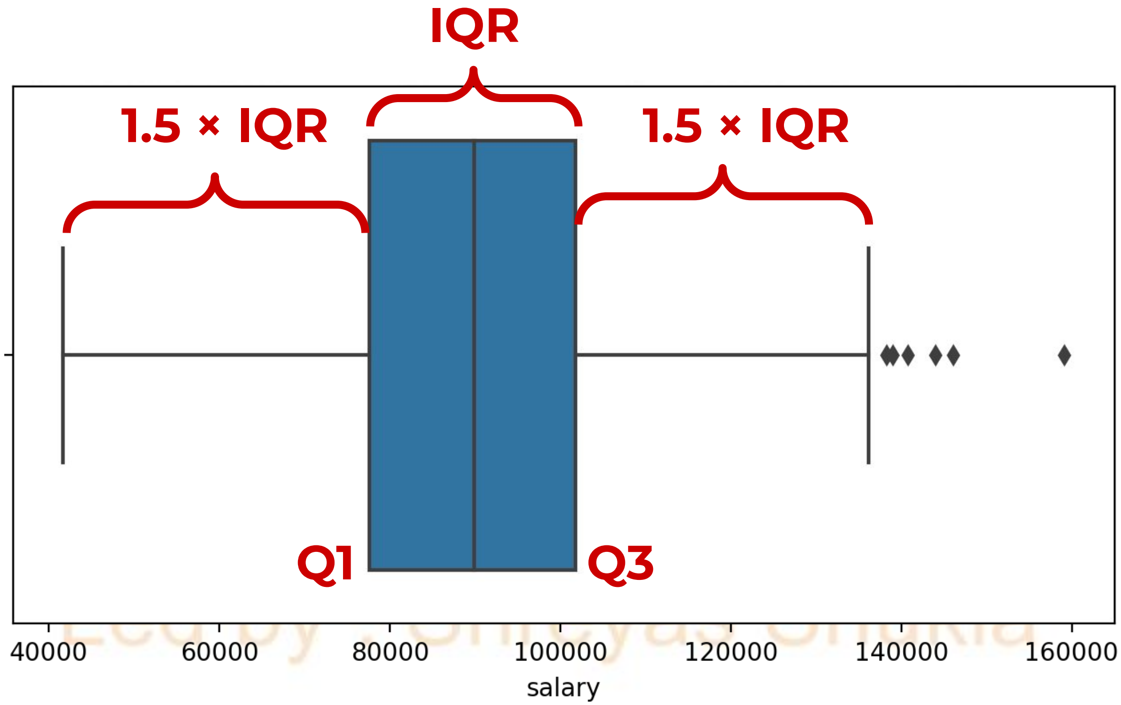
The “whiskers” are defined by 1.5 × IQR



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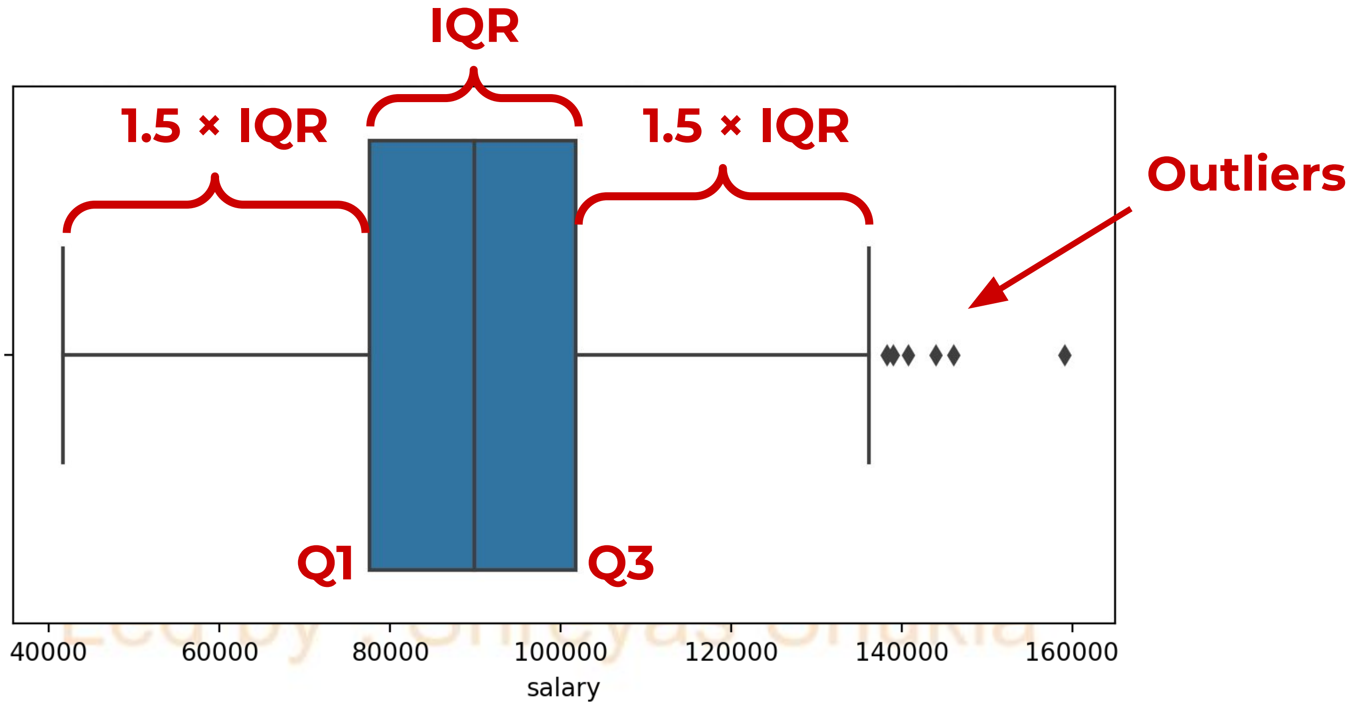
Outside of the whiskers are outliers



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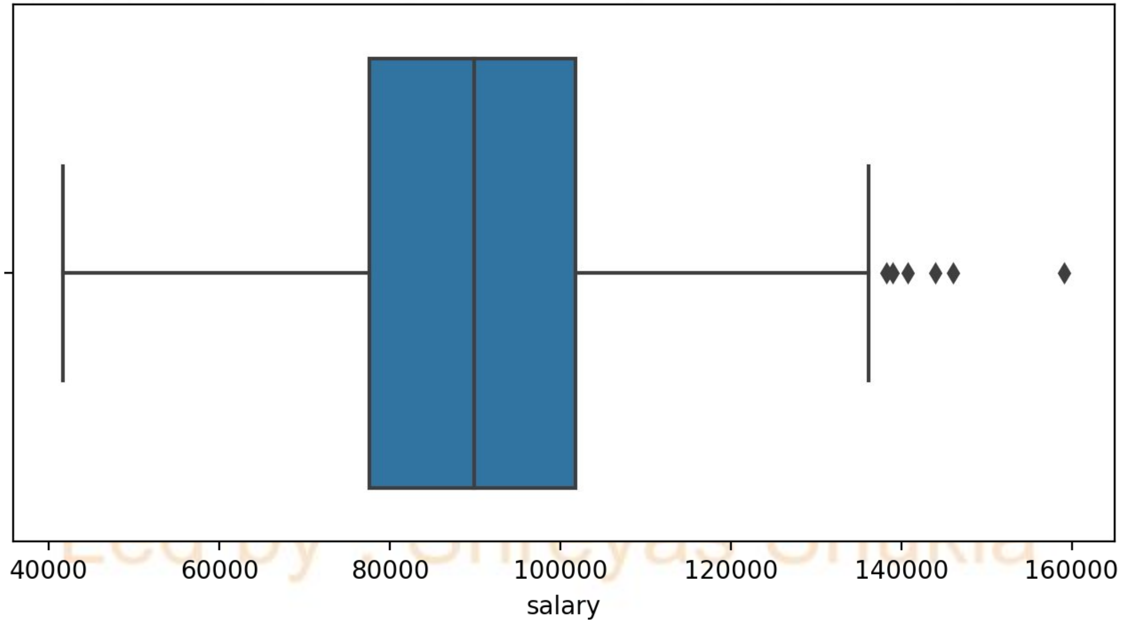
Boxplot gives statistical distribution information in a visual format:



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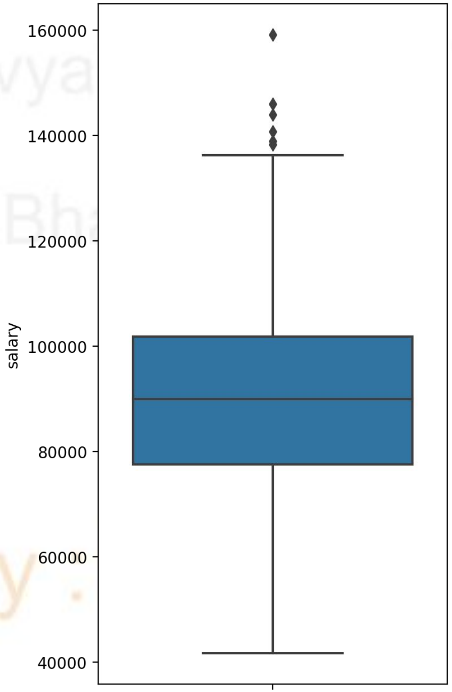
Boxplot can be oriented vertically or horizontally.



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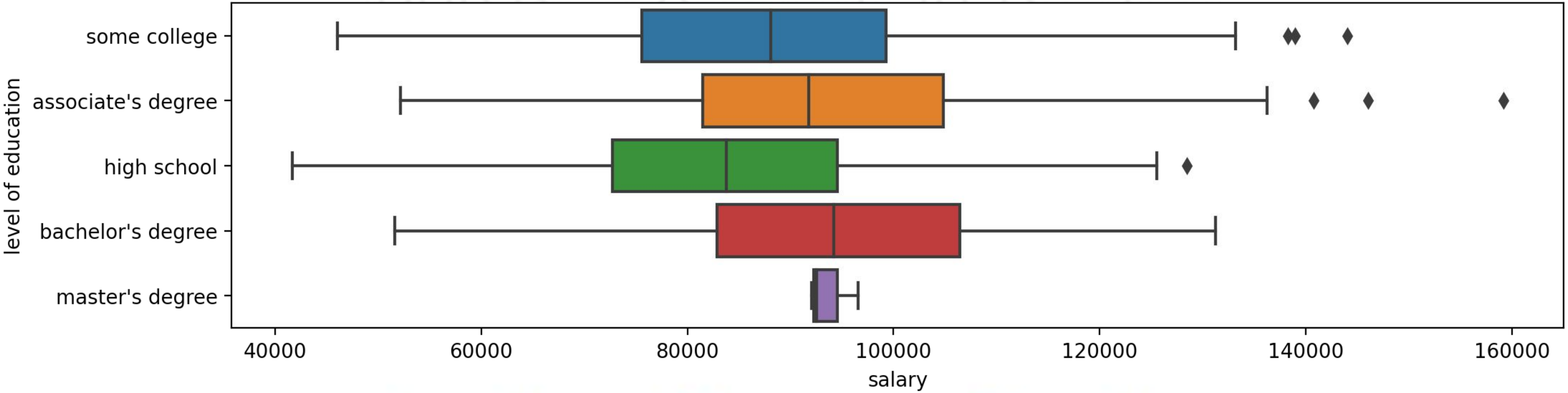
We can create a box plot **per** category!



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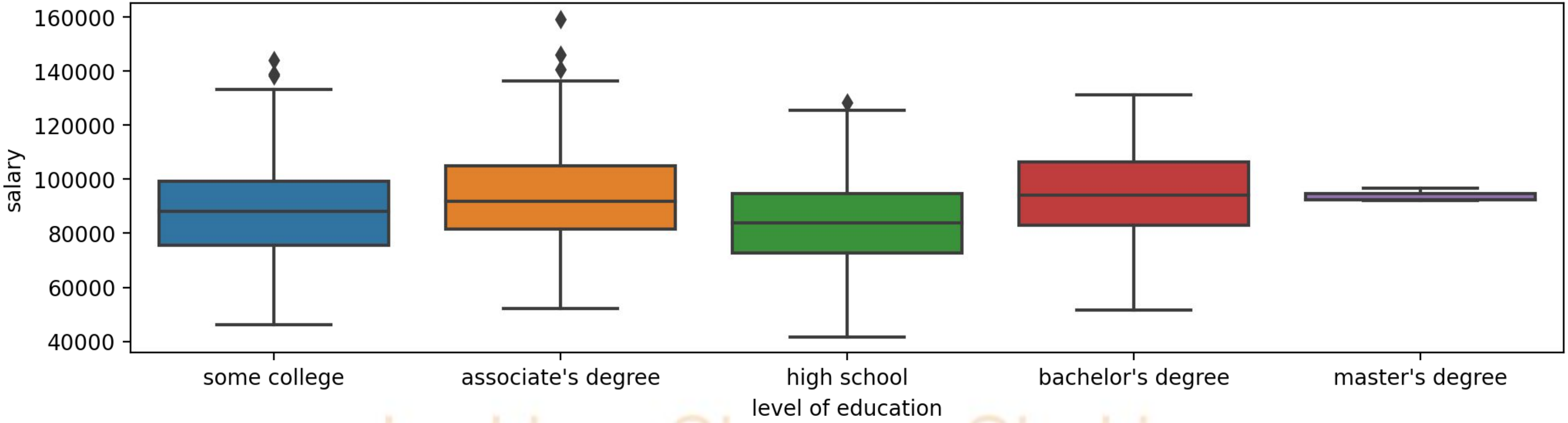

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The violin plot plays a similar role as the box plot. It displays the probability density across the data using a KDE.

We can imagine it as a mirrored KDE plot.

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The violin plot plays a similar role as the box plot. It displays the probability density across the data using a KDE.

We can imagine it as a mirrored KDE plot.

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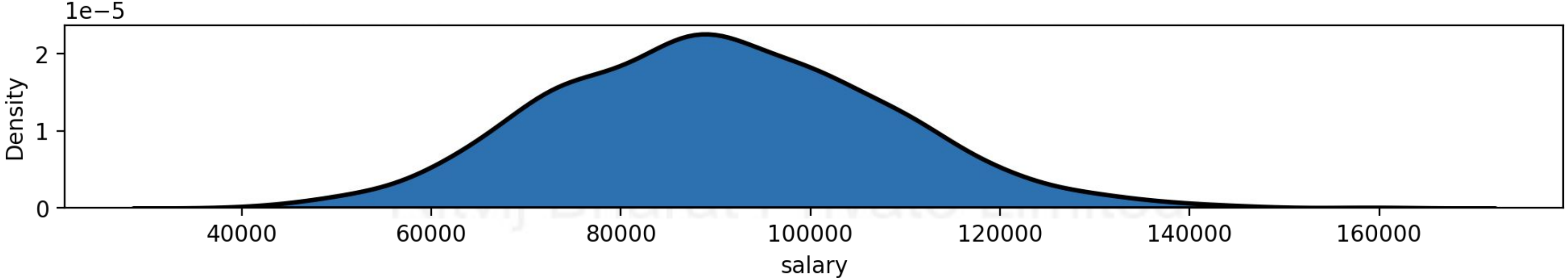
We take the KDE of a single feature:



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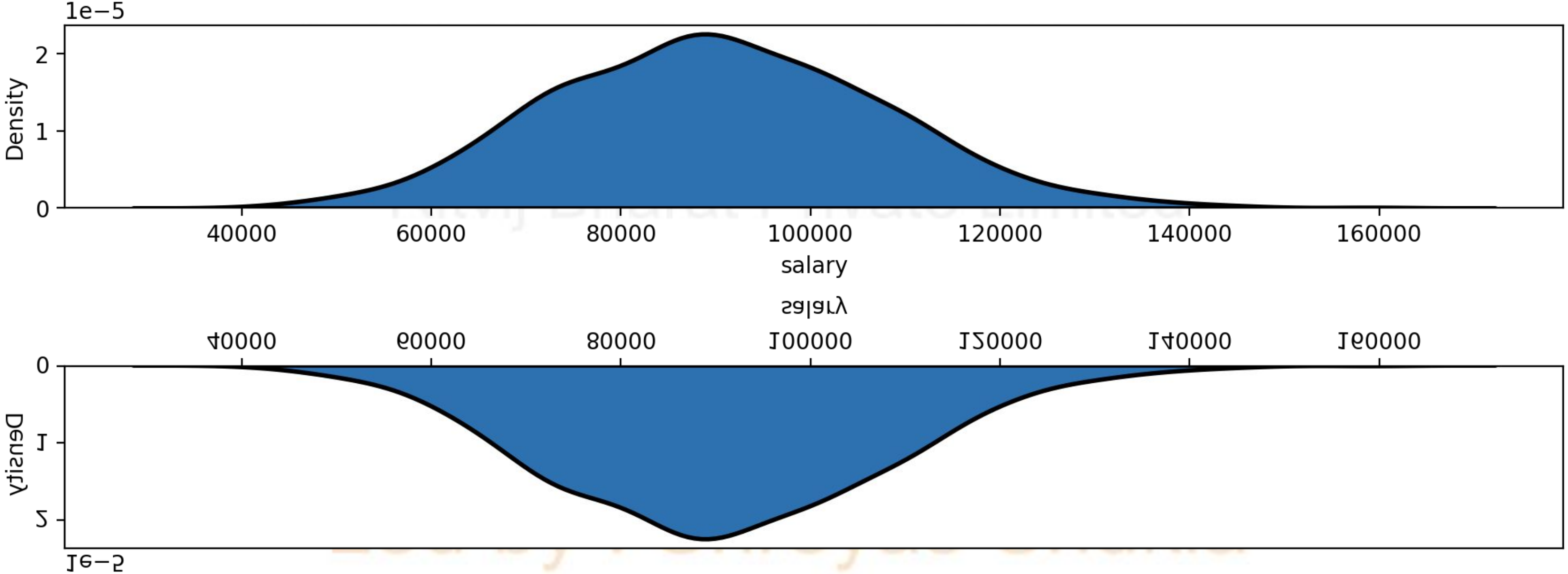
We could then “mirror” it:



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Then combine it to get the violin plot:

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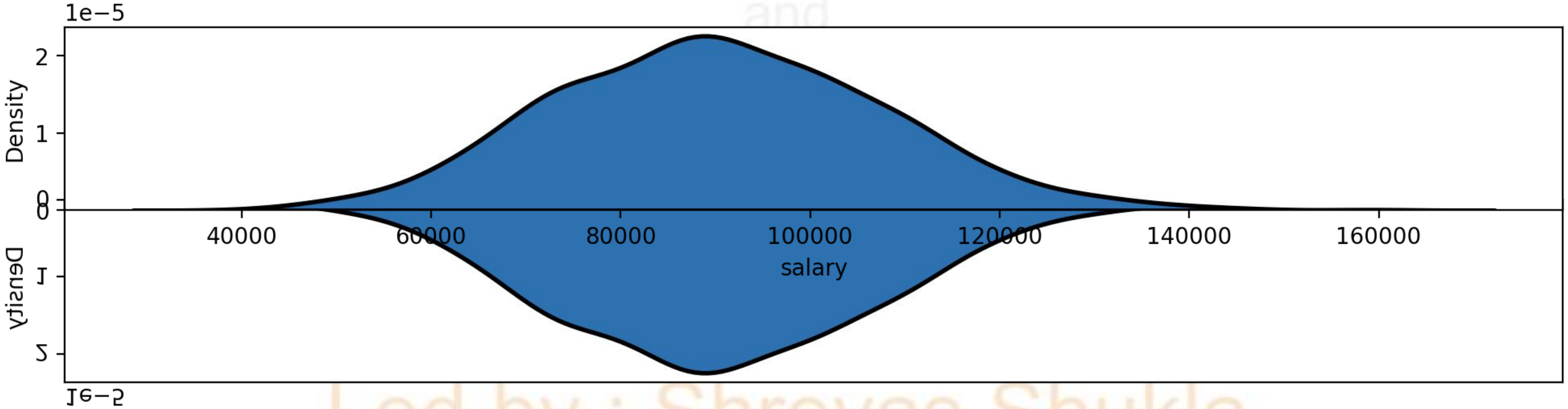
and



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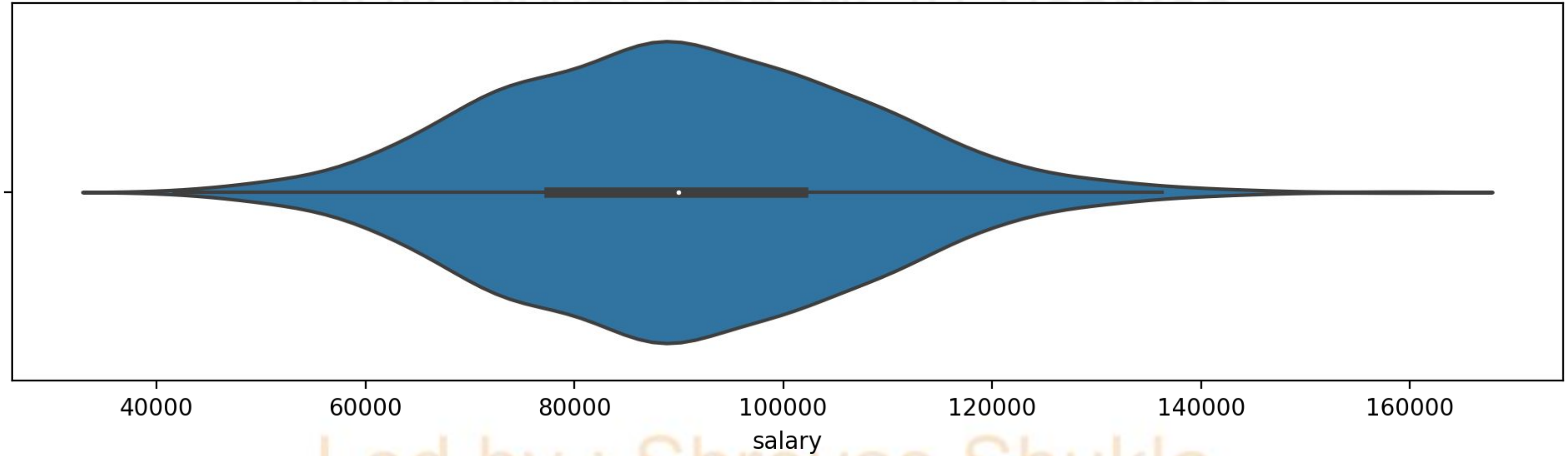
Then combine it to get the violin plot:



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The violin plots can then be created **per** category:

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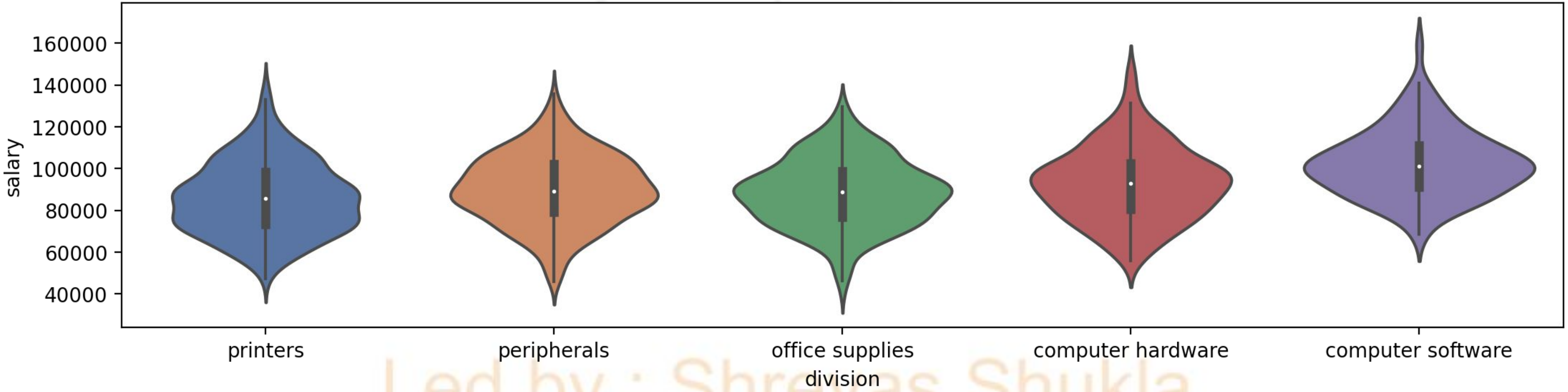

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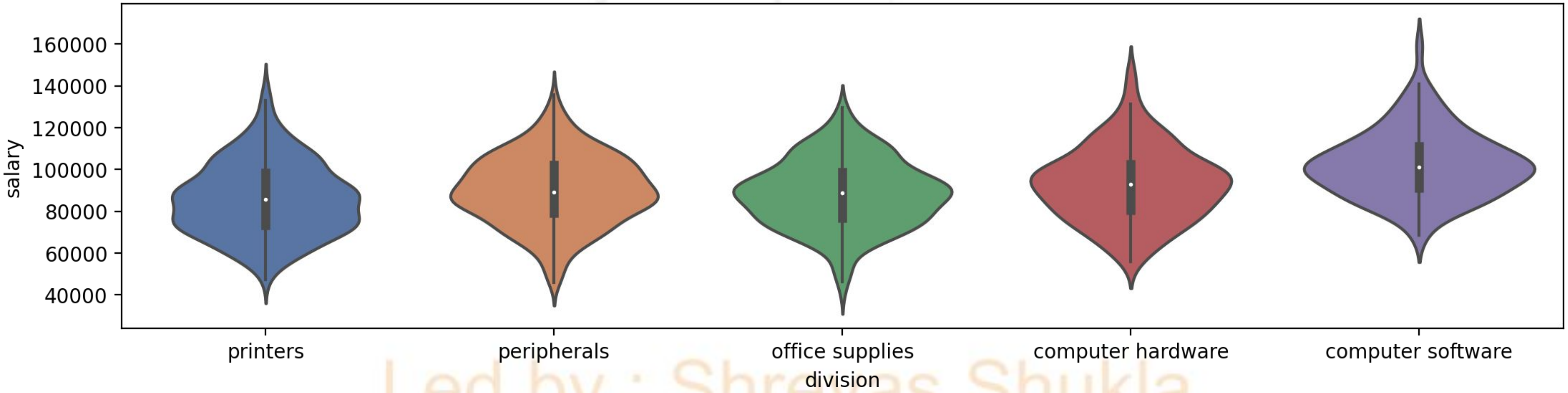

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A few more less common categorical distribution plot, that is, swarmplot .

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Let’s quickly explore this plot type...

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The swarmplot simply shows all the data points in the distribution.

(For very large data sets, it won’t show all the points, but will display the general distribution of them.)

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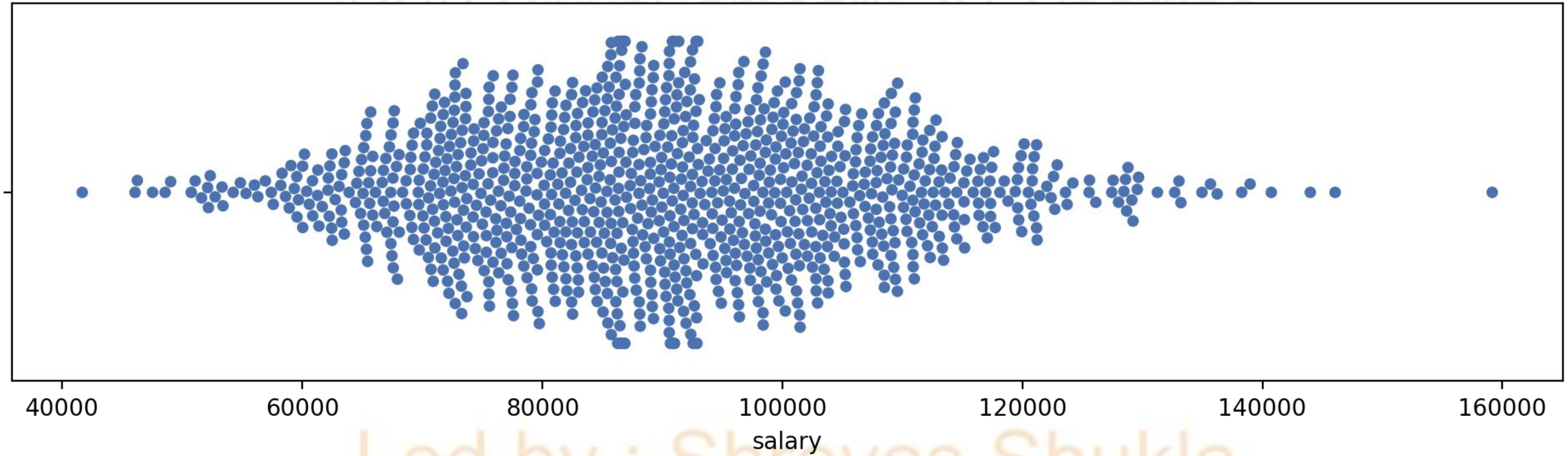

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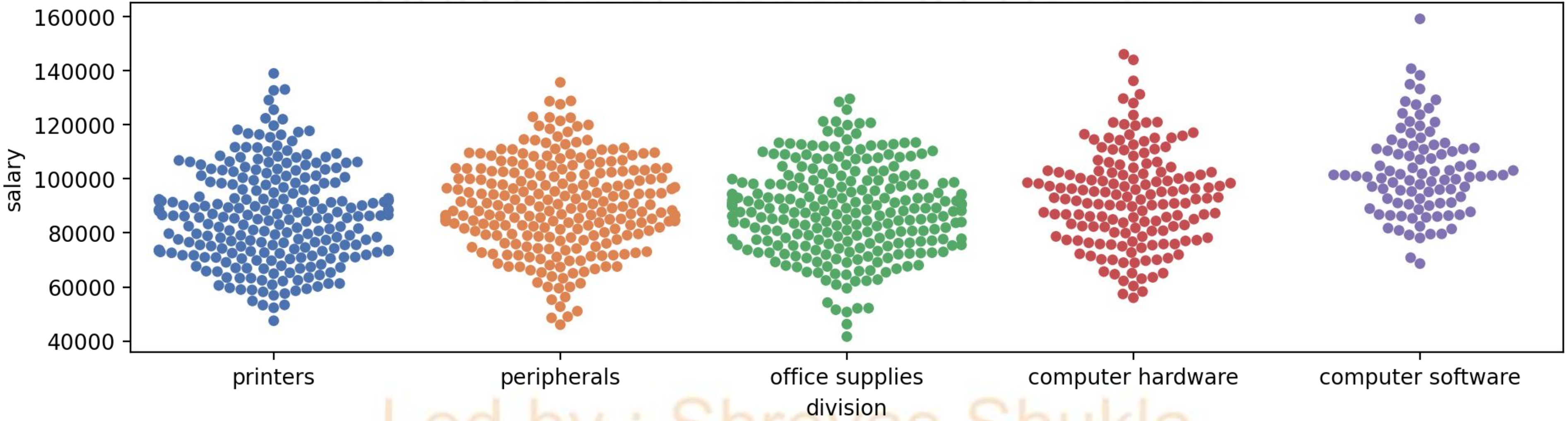

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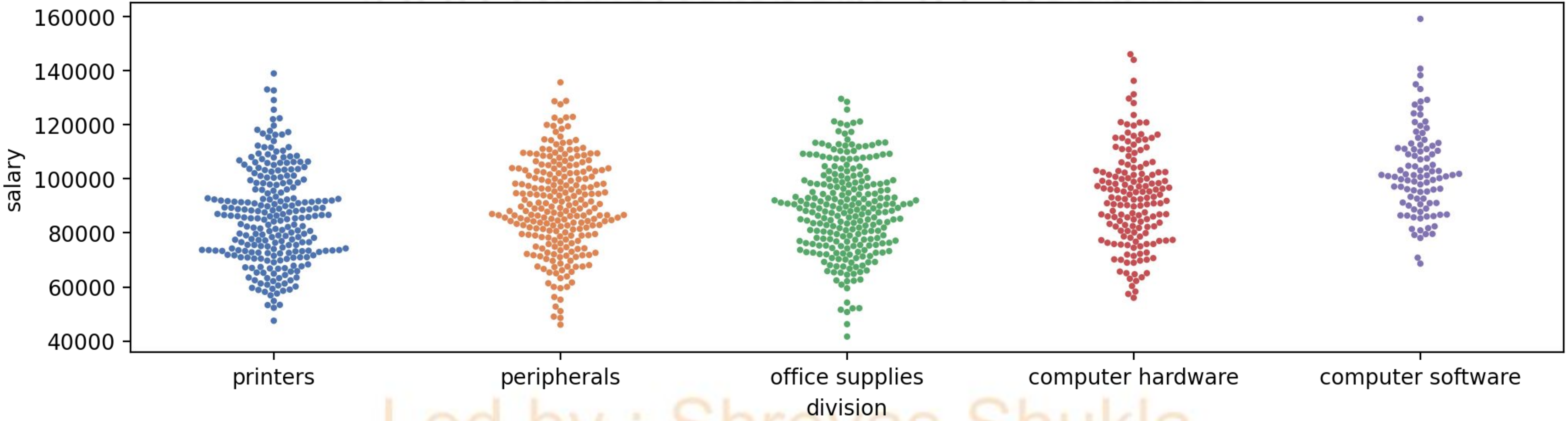

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That is it!!

Let’s code !!