In [ ]:

```
"""
GroupBy
Aggregation

"""
```

In [166]:

```
%matplotlib inline

import matplotlib
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

In [167]:

```
tips = pd.read_csv('data/tips.csv')
```

In [168]:

```
# Add tip % of total to DataFrame
tips['tip_pct'] = tips['tip'] / tips['total_bill']
```

In [169]:

```
tips.head()
```

Out[169]:

	total_bill	tip	sex	smoker	day	time	size	tip_pct
0	16.99	1.01	Female	No	Sun	Dinner	2	0.059447
1	10.34	1.66	Male	No	Sun	Dinner	3	0.160542
2	21.01	3.50	Male	No	Sun	Dinner	3	0.166587
3	23.68	3.31	Male	No	Sun	Dinner	2	0.139780
4	24.59	3.61	Female	No	Sun	Dinner	4	0.146808

In [170]:

```
# Group dataset by sex and smoker
grouped = tips.groupby(['sex', 'smoker'])
```

In [171]:

```
grouped_pct = grouped['tip_pct']
```

In [172]:

```
grouped_pct.agg('mean')
```

Out[172]:

```
sex     smoker
Female  No        0.156921
        Yes       0.182150
Male    No        0.160669
        Yes       0.152771
Name: tip_pct, dtype: float64
```

In [173]:

```
# We can do multiple aggregation functions
grouped_pct.agg(['mean', 'std'])
```

Out[173]:

		mean	**std**
sex	**smoker**		
Female	**No**	0.156921	0.036421
	Yes	0.182150	0.071595
Male	**No**	0.160669	0.041849
	Yes	0.152771	0.090588

In [174]:

```
# We can rename the columns
grouped_pct.agg([('Average', 'mean'), ('Standard Deviation', 'std')])
```

Out[174]:

		Average	**Standard Deviation**
sex	**smoker**		
Female	**No**	0.156921	0.036421
	Yes	0.182150	0.071595
Male	**No**	0.160669	0.041849
	Yes	0.152771	0.090588

In [175]:

```
# Can even do multiple functions on multiple columns
functions = ['count', 'mean', 'max']
result = grouped['tip_pct', 'total_bill'].agg(functions)
```

In [176]:

```
result
```

Out[176]:

		tip_pct			**total_bill**		
		count	**mean**	**max**	**count**	**mean**	**max**
sex	**smoker**						
Female	**No**	54	0.156921	0.252672	54	18.105185	35.83
	Yes	33	0.182150	0.416667	33	17.977879	44.30
Male	**No**	97	0.160669	0.291990	97	19.791237	48.33
	Yes	60	0.152771	0.710345	60	22.284500	50.81

In [177]:

```
# Can apply different functions to different columns
grouped.agg({'tip': 'max', 'size': 'sum'})
```

Out[177]:

		tip	size
sex	**smoker**		
Female	**No**	5.2	140
	Yes	6.5	74
Male	**No**	9.0	263
	Yes	10.0	150

In [178]:

```
# Applying multiple functions on some columns
grouped.agg({'tip_pct': ['min', 'max', 'mean', 'std'], 'size': 'sum'})
```

Out[178]:

		tip_pct				size
		min	**max**	**mean**	**std**	**sum**
sex	**smoker**					
Female	**No**	0.056797	0.252672	0.156921	0.036421	140
	Yes	0.056433	0.416667	0.182150	0.071595	74
Male	**No**	0.071804	0.291990	0.160669	0.041849	263
	Yes	0.035638	0.710345	0.152771	0.090588	150

In [179]:

```
# Function to return top n rows of df by given column
def top(df, n=5, column='tip_pct'):
    return df.sort_index(by=column, ascending=False)[:n]
```

In [180]:

```
top(tips, n=6)
```

Out[180]:

	total_bill	tip	sex	smoker	day	time	size	tip_pct
172	7.25	5.15	Male	Yes	Sun	Dinner	2	0.710345
178	9.60	4.00	Female	Yes	Sun	Dinner	2	0.416667
67	3.07	1.00	Female	Yes	Sat	Dinner	1	0.325733
232	11.61	3.39	Male	No	Sat	Dinner	2	0.291990
183	23.17	6.50	Male	Yes	Sun	Dinner	4	0.280535
109	14.31	4.00	Female	Yes	Sat	Dinner	2	0.279525

In [181]:

```
# We can apply this function on groups too
tips.groupby('smoker').apply(top)
```

Out[181]:

		total_bill	tip	sex	smoker	day	time	size	tip_pct
smoker									
No	**232**	11.61	3.39	Male	No	Sat	Dinner	2	0.291990
	149	7.51	2.00	Male	No	Thur	Lunch	2	0.266312
	51	10.29	2.60	Female	No	Sun	Dinner	2	0.252672
	185	20.69	5.00	Male	No	Sun	Dinner	5	0.241663
	88	24.71	5.85	Male	No	Thur	Lunch	2	0.236746
Yes	**172**	7.25	5.15	Male	Yes	Sun	Dinner	2	0.710345
	178	9.60	4.00	Female	Yes	Sun	Dinner	2	0.416667
	67	3.07	1.00	Female	Yes	Sat	Dinner	1	0.325733
	183	23.17	6.50	Male	Yes	Sun	Dinner	4	0.280535
	109	14.31	4.00	Female	Yes	Sat	Dinner	2	0.279525

In [182]:

```
tips.groupby(['smoker', 'day']).apply(top, n=1, column='total_bill')
```

Out[182]:

			total_bill	tip	sex	smoker	day	time	size	tip_pct
smoker	**day**									
No	**Fri**	**94**	22.75	3.25	Female	No	Fri	Dinner	2	0.142857
	Sat	**212**	48.33	9.00	Male	No	Sat	Dinner	4	0.186220
	Sun	**156**	48.17	5.00	Male	No	Sun	Dinner	6	0.103799
	Thur	**142**	41.19	5.00	Male	No	Thur	Lunch	5	0.121389
Yes	**Fri**	**95**	40.17	4.73	Male	Yes	Fri	Dinner	4	0.117750
	Sat	**170**	50.81	10.00	Male	Yes	Sat	Dinner	3	0.196812
	Sun	**182**	45.35	3.50	Male	Yes	Sun	Dinner	3	0.077178
	Thur	**197**	43.11	5.00	Female	Yes	Thur	Lunch	4	0.115982

In [183]:

```
# PIVOT TABLES
# Aggregate a dataframe by one or more keys, arranging data with some of the
tips.pivot_table(index=['sex', 'smoker'])
```

Out[183]:

		size	tip	tip_pct	total_bill
sex	**smoker**				
Female	**No**	2.592593	2.773519	0.156921	18.105185
	Yes	2.242424	2.931515	0.182150	17.977879
Male	**No**	2.711340	3.113402	0.160669	19.791237
	Yes	2.500000	3.051167	0.152771	22.284500

In [184]:

```
tips.pivot_table(['tip_pct', 'size'], index=['sex', 'day'], columns='smoker'
```

Out[184]:

		tip_pct			size		
	smoker	**No**	**Yes**	**All**	**No**	**Yes**	**All**
sex	**day**						
Female	**Fri**	0.165296	0.209129	0.199388	2.500000	2.000000	2.111111
	Sat	0.147993	0.163817	0.156470	2.307692	2.200000	2.250000
	Sun	0.165710	0.237075	0.181569	3.071429	2.500000	2.944444
	Thur	0.155971	0.163073	0.157525	2.480000	2.428571	2.468750
Male	**Fri**	0.138005	0.144730	0.143385	2.000000	2.125000	2.100000
	Sat	0.162132	0.139067	0.151577	2.656250	2.629630	2.644068
	Sun	0.158291	0.173964	0.162344	2.883721	2.600000	2.810345
	Thur	0.165706	0.164417	0.165276	2.500000	2.300000	2.433333
All		0.159328	0.163196	0.160803	2.668874	2.408602	2.569672

In [185]:

```
# We can pass a different agg function
# This gets number of guests by sex, smoker, and day
tips.pivot_table(['size'], index=['sex', 'smoker'], columns='day', aggfunc='
```

Out[185]:

		size				
	day	**Fri**	**Sat**	**Sun**	**Thur**	**All**
sex	**smoker**					
Female	**No**	5	30	43	62	140
	Yes	14	33	10	17	74
Male	**No**	4	85	124	50	263
	Yes	17	71	39	23	150
All		40	219	216	152	627

In [186]:

```
# Verify pivot table above
tips[(tips['day'] == 'Fri') & (tips['sex'] == 'Female') & (tips['smoker'] ==
```

Out[186]:

	total_bill	tip	sex	smoker	day	time	size	tip_pct
94	22.75	3.25	Female	No	Fri	Dinner	2	0.142857
223	15.98	3.00	Female	No	Fri	Lunch	3	0.187735

In [187]:

```
# Get number of bills by sex, smoker, and day.
pd.crosstab([tips.sex, tips.smoker], tips.day, margins=True)
```

Out[187]:

	day	Fri	Sat	Sun	Thur	All
sex	**smoker**					
Female	**No**	2	13	14	25	54
	Yes	7	15	4	7	33
Male	**No**	2	32	43	20	97
	Yes	8	27	15	10	60
All		19	87	76	62	244

In [188]:

```
# Cross-Tabulation is a special case of a pivot table that computes group fr
# This gets number of bills by time, day and smoker.
pd.crosstab([tips.time, tips.day], tips.smoker, margins=True)
```

Out[188]:

	smoker	No	Yes	All
time	**day**			
Dinner	**Fri**	3	9	12
	Sat	45	42	87
	Sun	57	19	76
	Thur	1	0	1
Lunch	**Fri**	1	6	7
	Thur	44	17	61
All		151	93	244

In [191]:

```
# Get cross-tab by day and party size
party_counts = pd.crosstab(tips['day'], tips['size'])
party_counts
```

Out[191]:

size	1	2	3	4	5	6
day						
Fri	1	16	1	1	0	0
Sat	2	53	18	13	1	0
Sun	0	39	15	18	3	1
Thur	1	48	4	5	1	3

In [81]:

```
# Filter out parties of 1 and 6 since so few
party_counts = party_counts.ix[:, 2:5]
```

In [82]:

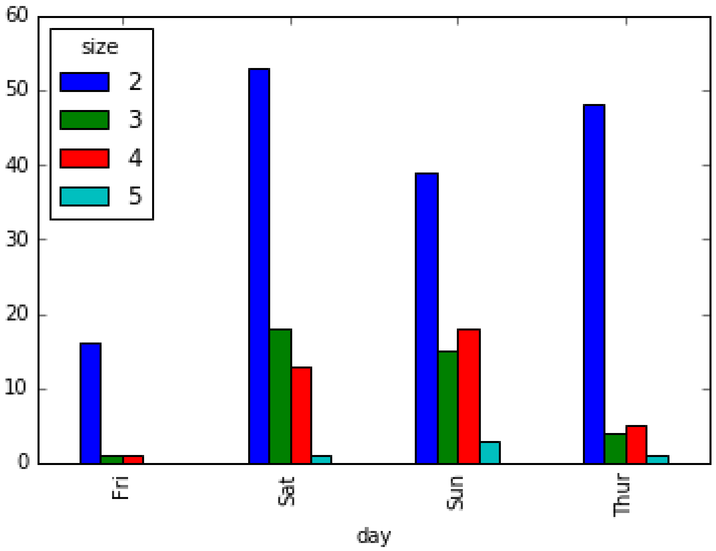
```
party_counts
```

Out[82]:

size	2	3	4	5
day				
Fri	16	1	1	0
Sat	53	18	13	1
Sun	39	15	18	3
Thur	48	4	5	1

```
In [84]: # BAR CHART
         party_counts.plot(kind='bar')

Out[84]: <matplotlib.axes._subplots.AxesSubplot at 0x113cec050>
```



```
In [85]: # Normalize data
         party_pcts = party_counts.div(party_counts.sum(1).astype(float), axis=0)
```

```
In [86]: party_pcts
```

Out[86]:

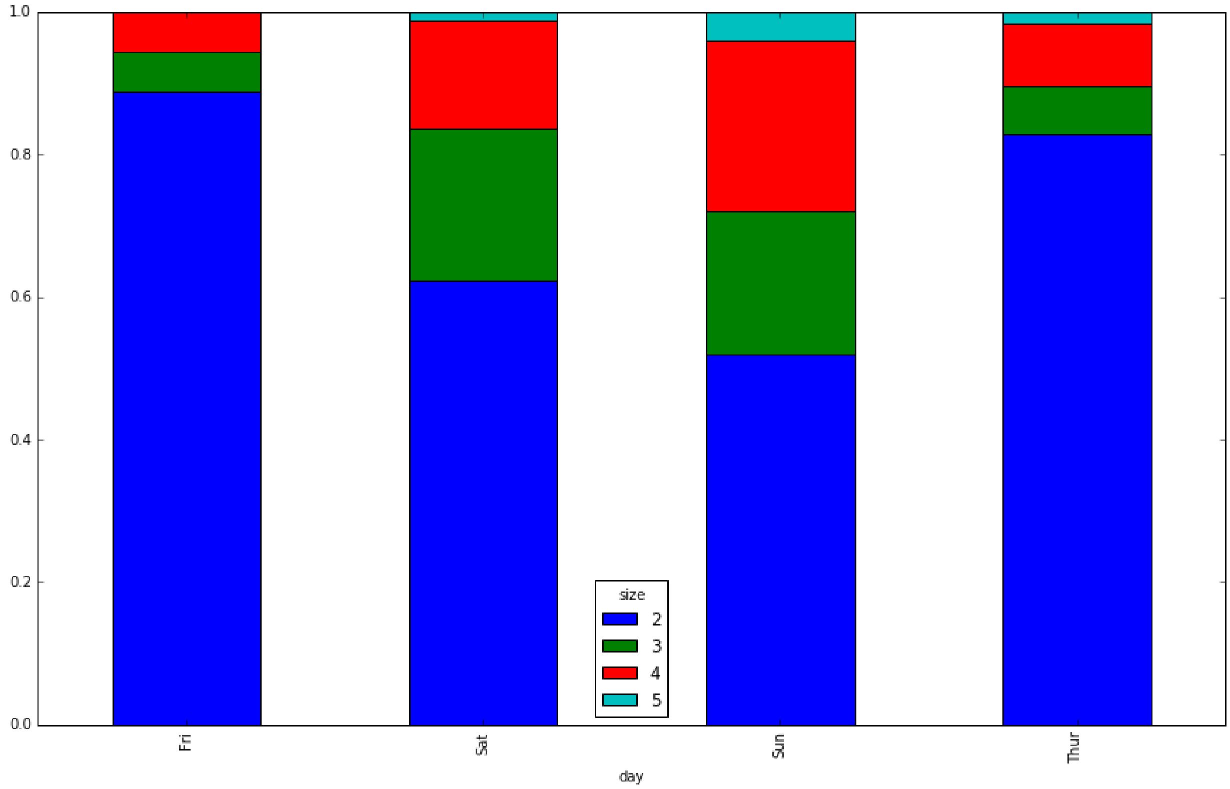
size	2	3	4	5
day				
Fri	0.888889	0.055556	0.055556	0.000000
Sat	0.623529	0.211765	0.152941	0.011765
Sun	0.520000	0.200000	0.240000	0.040000
Thur	0.827586	0.068966	0.086207	0.017241

In [95]:

```
# NORMALIZED BAR CHART
party_pcts.plot(kind='bar', stacked=True, figsize=(15, 9))
```

Out[95]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x11477c710>
```



In [89]:

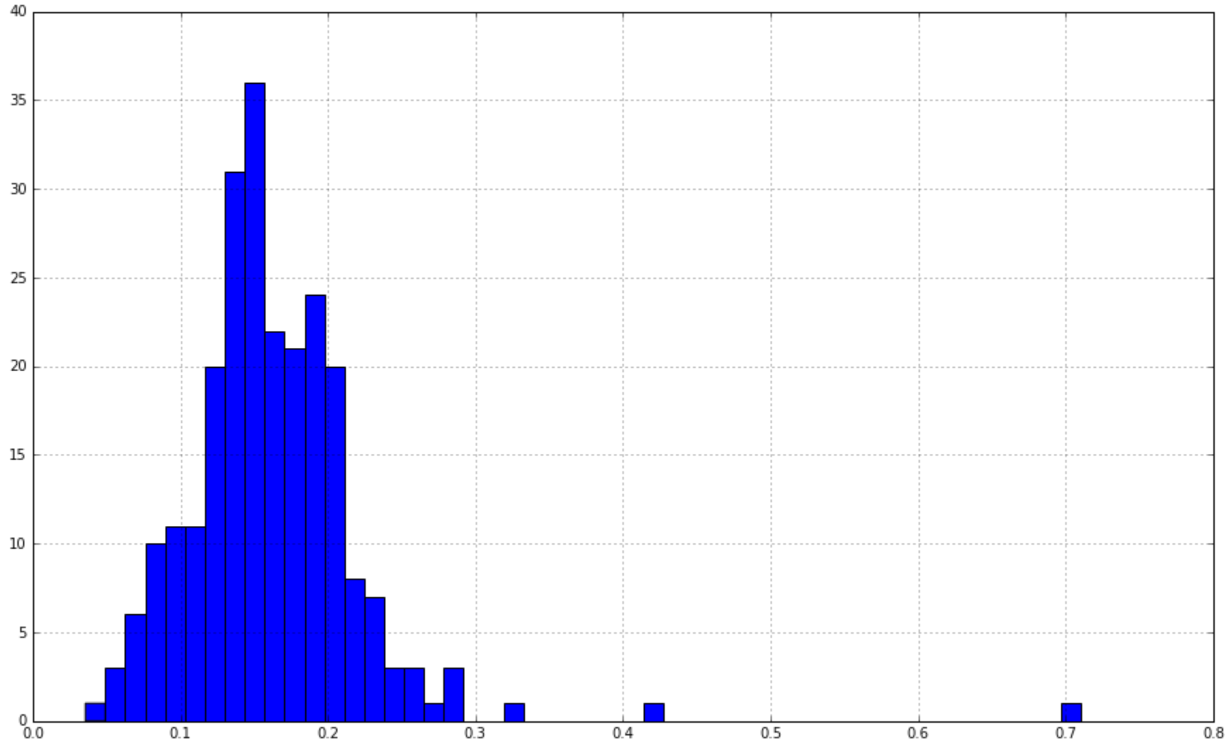
```
# Add % tip column
tips['tip_pct'] = tips['tip'] / tips['total_bill']
```

In [92]:

```
# HISTOGRAM
tips['tip_pct'].hist(bins=50, figsize=(15, 9))
```

Out[92]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x113d09850>
```

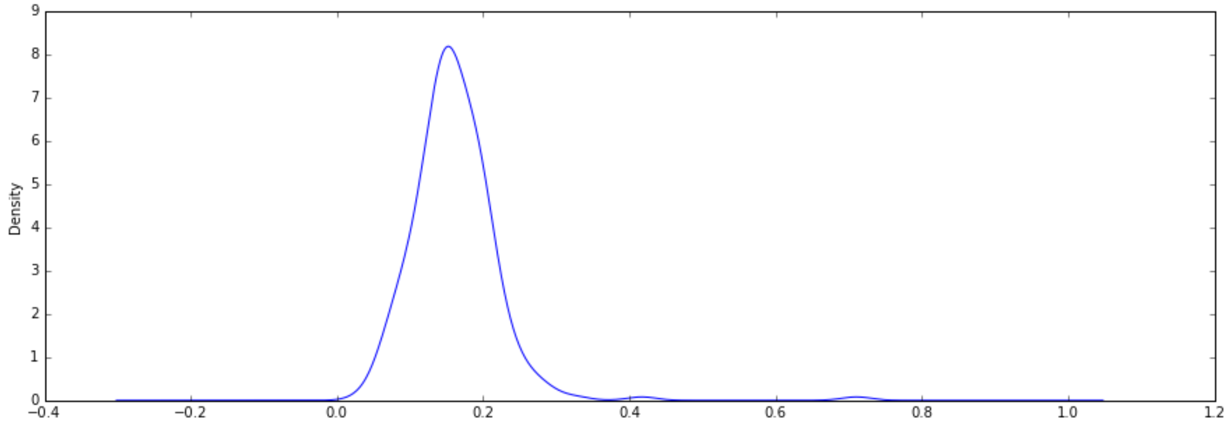


In [100]:

```
# DENSITY PLOT (KERNEL DENSITY ESTIMATE)
tips['tip_pct'].plot(kind='kde', figsize=(15, 5))
```

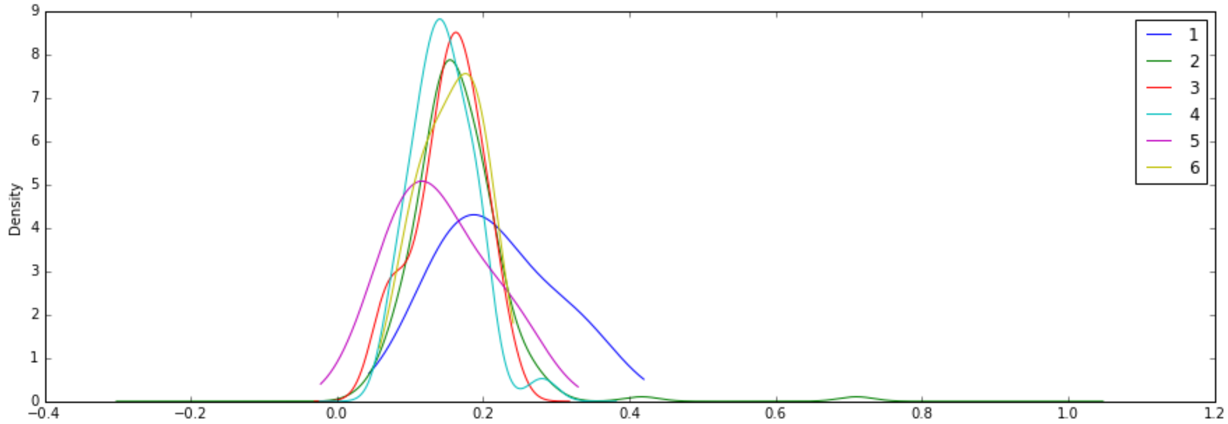
Out[100]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x116d118d0>
```



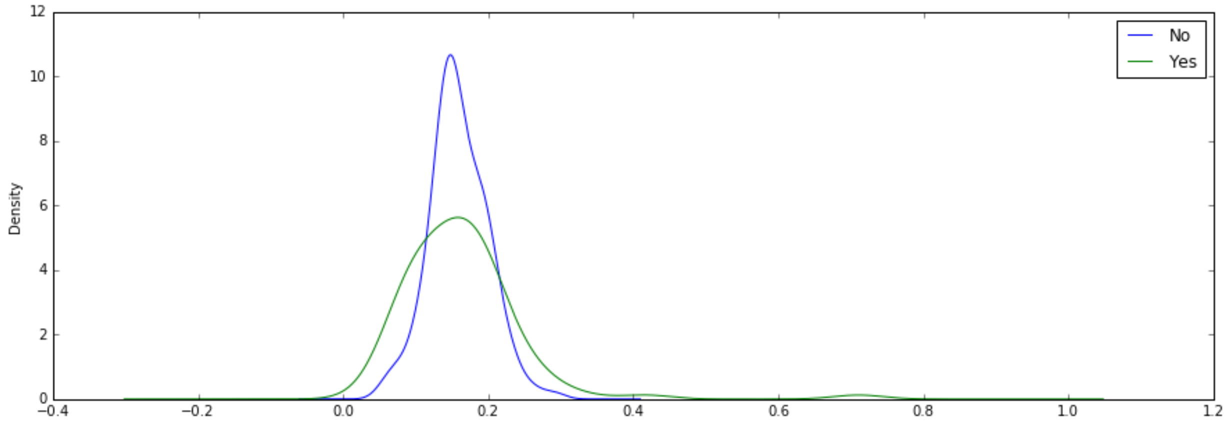
```
In [102]: # Tip percentage density based on party size
          tips['tip_pct'].groupby(tips['size']).plot(kind='kde', figsize=(15, 5), lege
```

```
Out[102]: size
          1     Axes(0.125,0.125;0.775x0.775)
          2     Axes(0.125,0.125;0.775x0.775)
          3     Axes(0.125,0.125;0.775x0.775)
          4     Axes(0.125,0.125;0.775x0.775)
          5     Axes(0.125,0.125;0.775x0.775)
          6     Axes(0.125,0.125;0.775x0.775)
          dtype: object
```



```
In [193]: # Tipping density for smokers/non-smokers
          tips['tip_pct'].groupby(tips.smoker).plot(kind='kde', figsize=(15, 5), legen
```

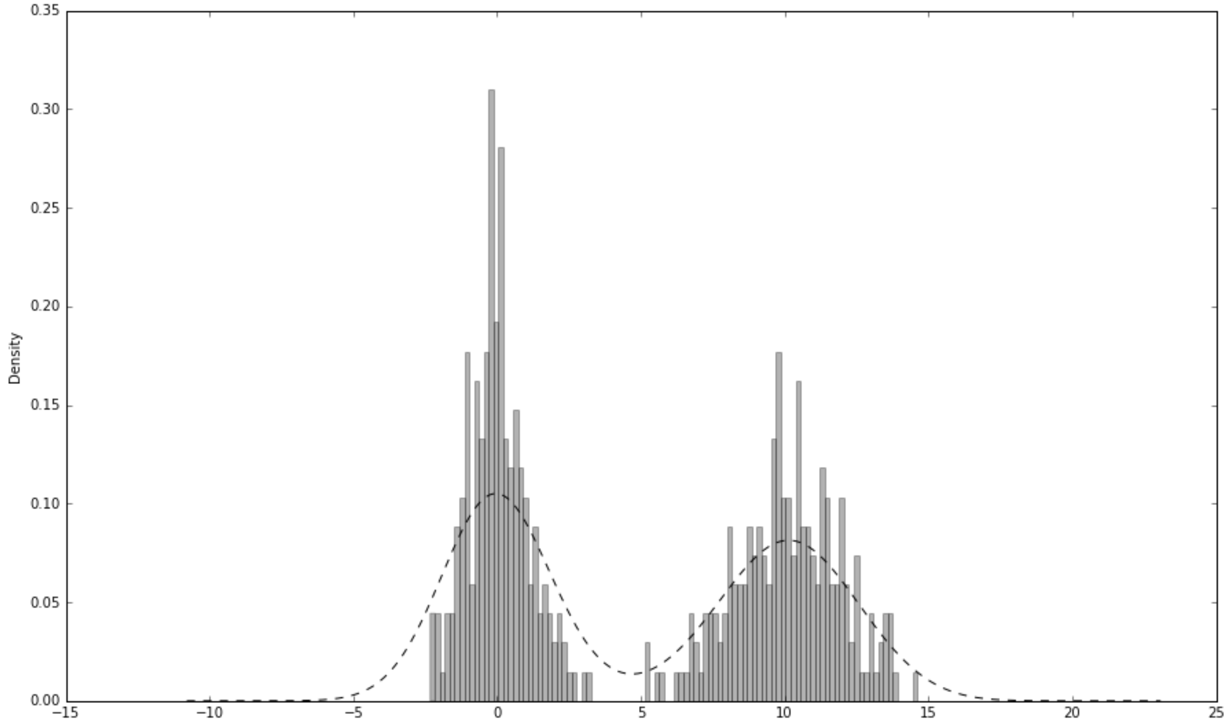
```
Out[193]: smoker
          No      Axes(0.125,0.125;0.775x0.775)
          Yes     Axes(0.125,0.125;0.775x0.775)
          dtype: object
```



```
In [192]: # Density plot of two normally distributed draws
          draw_1 = np.random.normal(0, 1, size=200)
          draw_2 = np.random.normal(10, 2, size=200)  # 2^2 = 4

          values = pd.Series(np.concatenate([draw_1, draw_2]))
          values.hist(bins=100, alpha=0.3, color='k', normed=True, figsize=(15,9))
          values.plot(kind='kde', style='k--', figsize=(15,9))
```

```
Out[192]: <matplotlib.axes._subplots.AxesSubplot at 0x1185ca850>
```



```
In [ ]:
```