Code for Term Project DSC 530-T301

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Referencing: ThinkStats Exploratory Data Analysis by Allen B. Downey 2nd Edition

In [1]:
```
import pandas as pd
from thinkstats2 import Mean, MeanVar, Var, Std, Cov
```

In [2]:
```
dataset = pd.read_csv("~/desktop/DSC520/Sleep_Efficiency.csv")
```

In [3]:
```
dataset.head()
```

Out[3]:

	ID	Age	Gender	Bedtime	Wakeup time	Sleep duration	Sleep efficiency	REM sleep percentage	Deep sleep percentage	Light sleep percentage	Awakenings	Caffeine consumption	Alcohol consumption	Smoking status	Exercise frequency
0	1	65	Female	2021-03-06 01:00:00	2021-03-06 07:00:00	6.0	0.88	18	70	12	0.0	0.0	0.0	Yes	3.0
1	2	69	Male	2021-12-05 02:00:00	2021-12-05 09:00:00	7.0	0.66	19	28	53	3.0	0.0	3.0	Yes	3.0
2	3	40	Female	2021-05-25 21:30:00	2021-05-25 05:30:00	8.0	0.89	20	70	10	1.0	0.0	0.0	No	3.0
3	4	40	Female	2021-11-03 02:30:00	2021-11-03 08:30:00	6.0	0.51	23	25	52	3.0	50.0	5.0	Yes	1.0
4	5	57	Male	2021-03-13 01:00:00	2021-03-13 09:00:00	8.0	0.76	27	55	18	3.0	0.0	3.0	No	3.0

In [4]:
```
dataset.columns
```

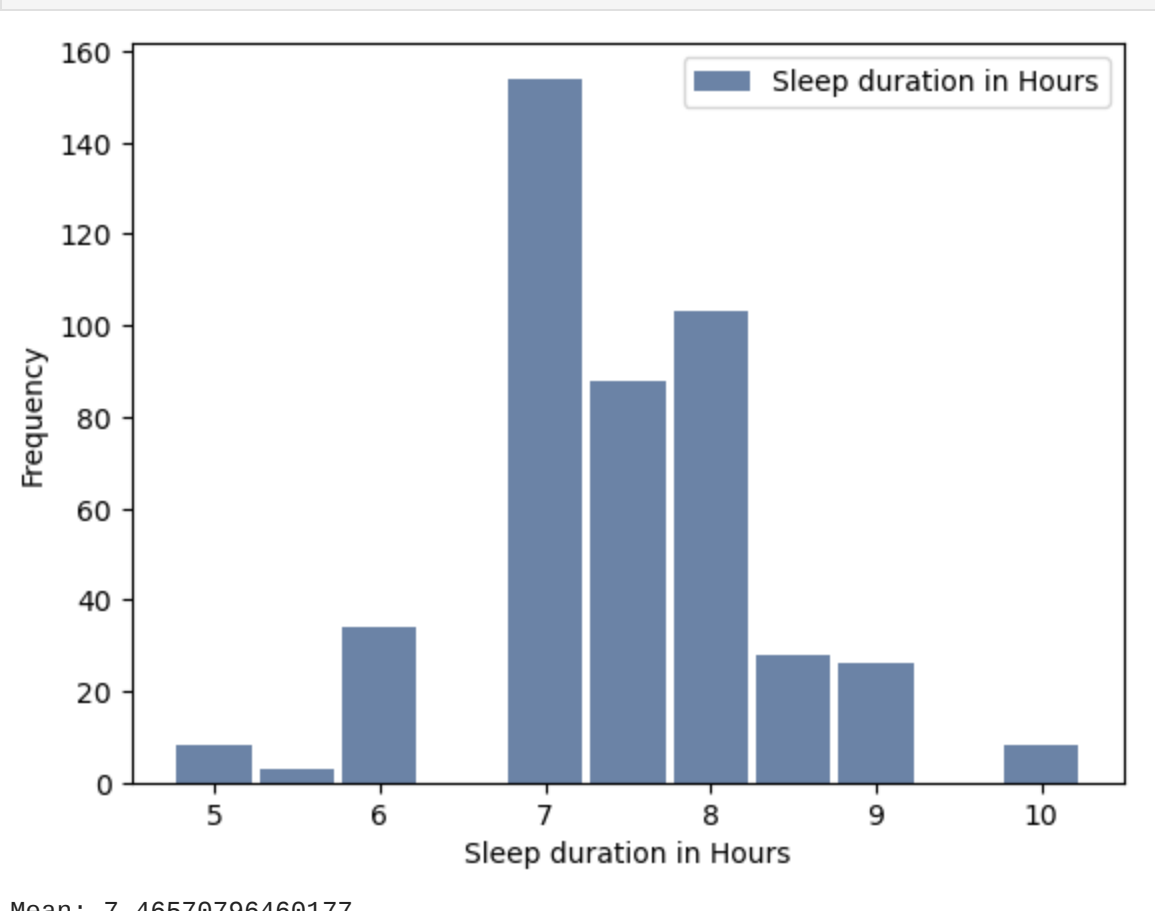
Out[4]:
```
Index(['ID', 'Age', 'Gender', 'Bedtime', 'Wakeup time', 'Sleep duration',
       'Sleep efficiency', 'REM sleep percentage', 'Deep sleep percentage',
       'Light sleep percentage', 'Awakenings', 'Caffeine consumption',
       'Alcohol consumption', 'Smoking status', 'Exercise frequency'],
      dtype='object')
```

In [5]:
```
import thinkplot
import thinkstats2
import numpy as np
```

Histograms of all the 5 variables with the mean, mode, spread, and tails

Histogram #1 Sleep Duration

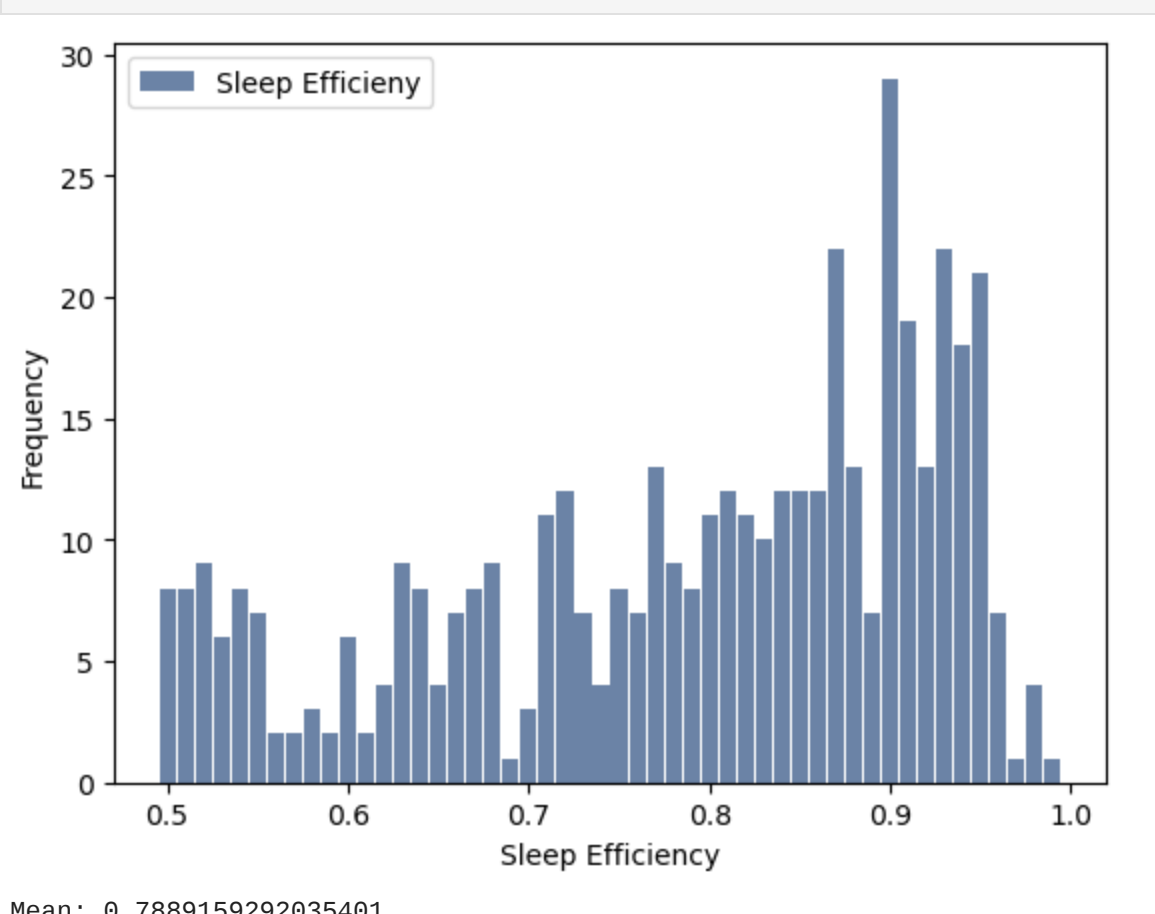
In [6]:
```
hist = thinkstats2.Hist(dataset["Sleep duration"],label = 'Sleep duration in Hours')
thinkplot.Hist(hist)
thinkplot.Show(xlabel = 'Sleep duration in Hours', ylabel = 'Frequency')
print("Mean:",Mean(dataset["Sleep duration"]))
```




```
Mean: 7.46570796460177
<Figure size 800x600 with 0 Axes>
```

Histogram #2 Sleep Effiency

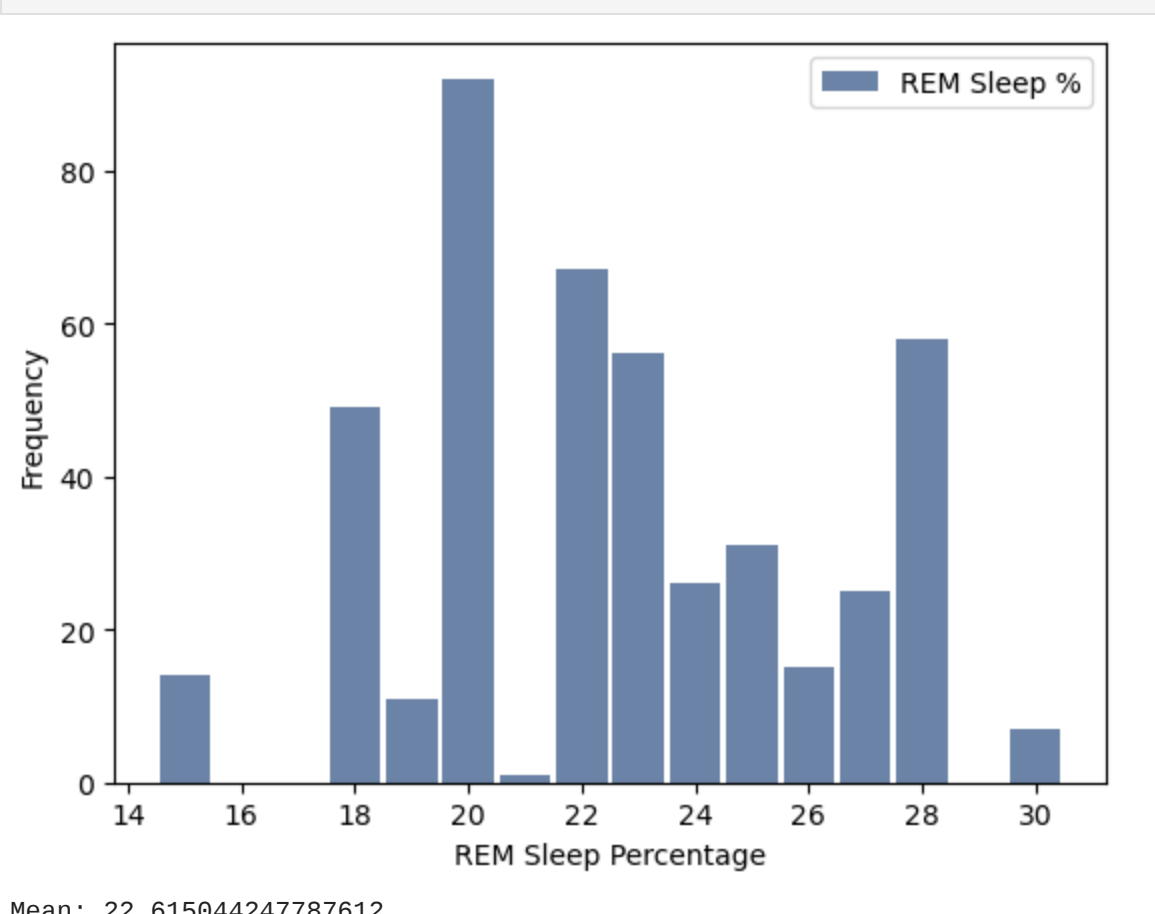
In [7]:
```
hist = thinkstats2.Hist(dataset["Sleep efficiency"],label = 'Sleep Efficieny')
thinkplot.Hist(hist)
thinkplot.Show(xlabel = 'Sleep Efficiency', ylabel = 'Frequency')
print("Mean:",Mean(dataset["Sleep efficiency"]))
```




```
Mean: 0.7889159292035401
<Figure size 800x600 with 0 Axes>
```

Histogram #3 REM Sleep Percentage

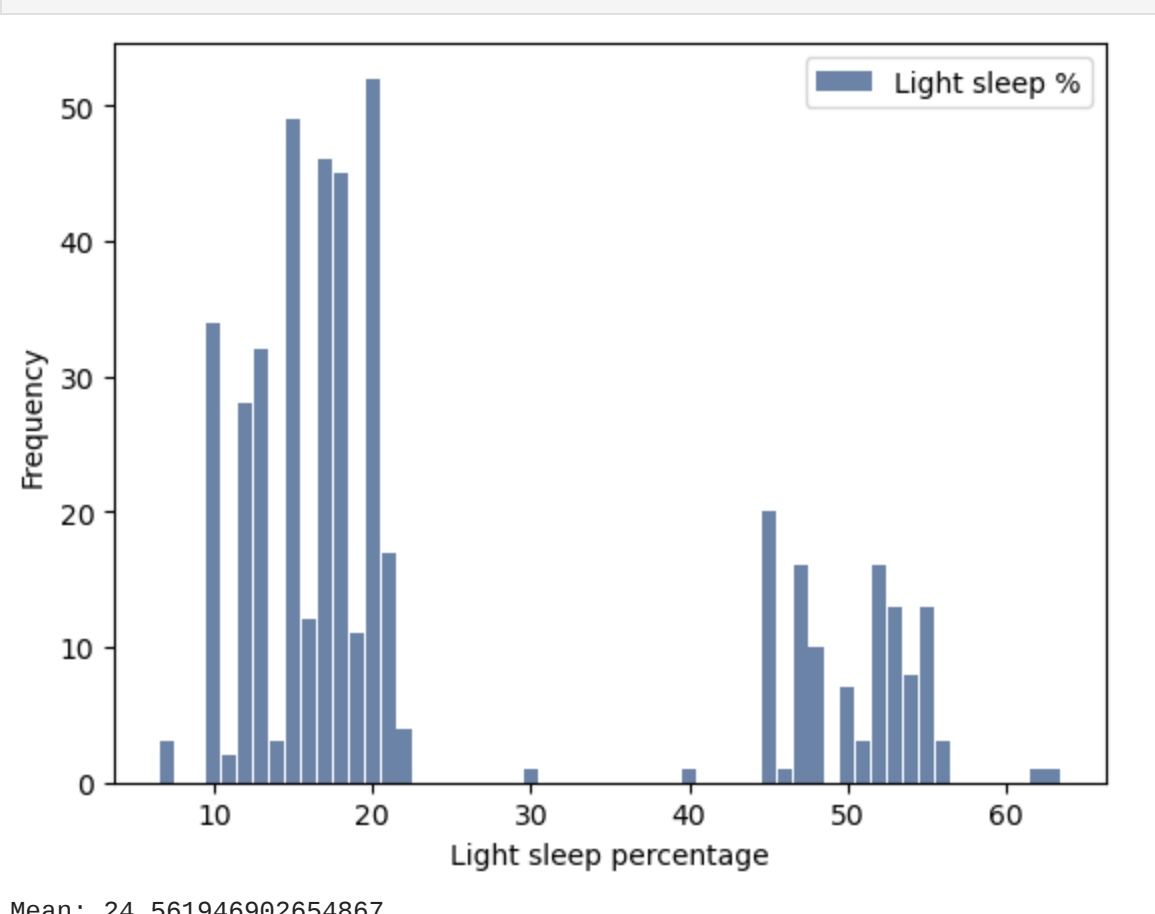
In [8]:
```
hist = thinkstats2.Hist(dataset["REM sleep percentage"],label = 'REM Sleep %')
thinkplot.Hist(hist)
thinkplot.Show(xlabel = 'REM Sleep Percentage', ylabel = 'Frequency')
print("Mean:",Mean(dataset["REM sleep percentage"]))
```




```
Mean: 22.615044247787612
<Figure size 800x600 with 0 Axes>
```

Histogram #1 Deep Sleep Percentage

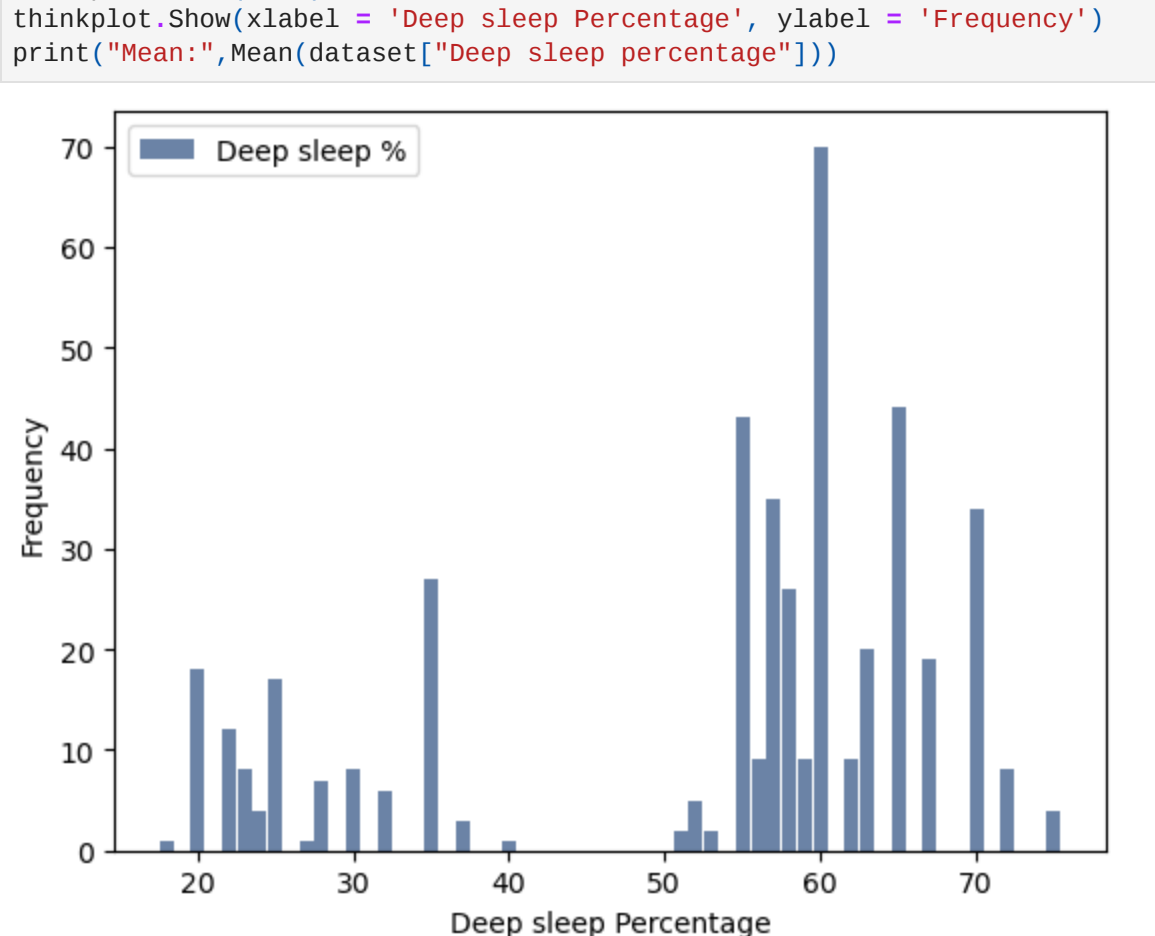
In [9]:
```
hist = thinkstats2.Hist(dataset["Light sleep percentage"],label = 'Light sleep %')
thinkplot.Hist(hist)
thinkplot.Show(xlabel = 'Light sleep percentage', ylabel = 'Frequency')
print("Mean:",Mean(dataset["Light sleep percentage"]))
```




```
Mean: 24.561946902654867
<Figure size 800x600 with 0 Axes>
```

Histogram #1 Light Sleep Percentage

In [10]:
```
hist = thinkstats2.Hist(dataset["Deep sleep percentage"],label = 'Deep sleep %')
thinkplot.Hist(hist)
thinkplot.Show(xlabel = 'Deep sleep Percentage', ylabel = 'Frequency')
print("Mean:",Mean(dataset["Deep sleep percentage"]))
```

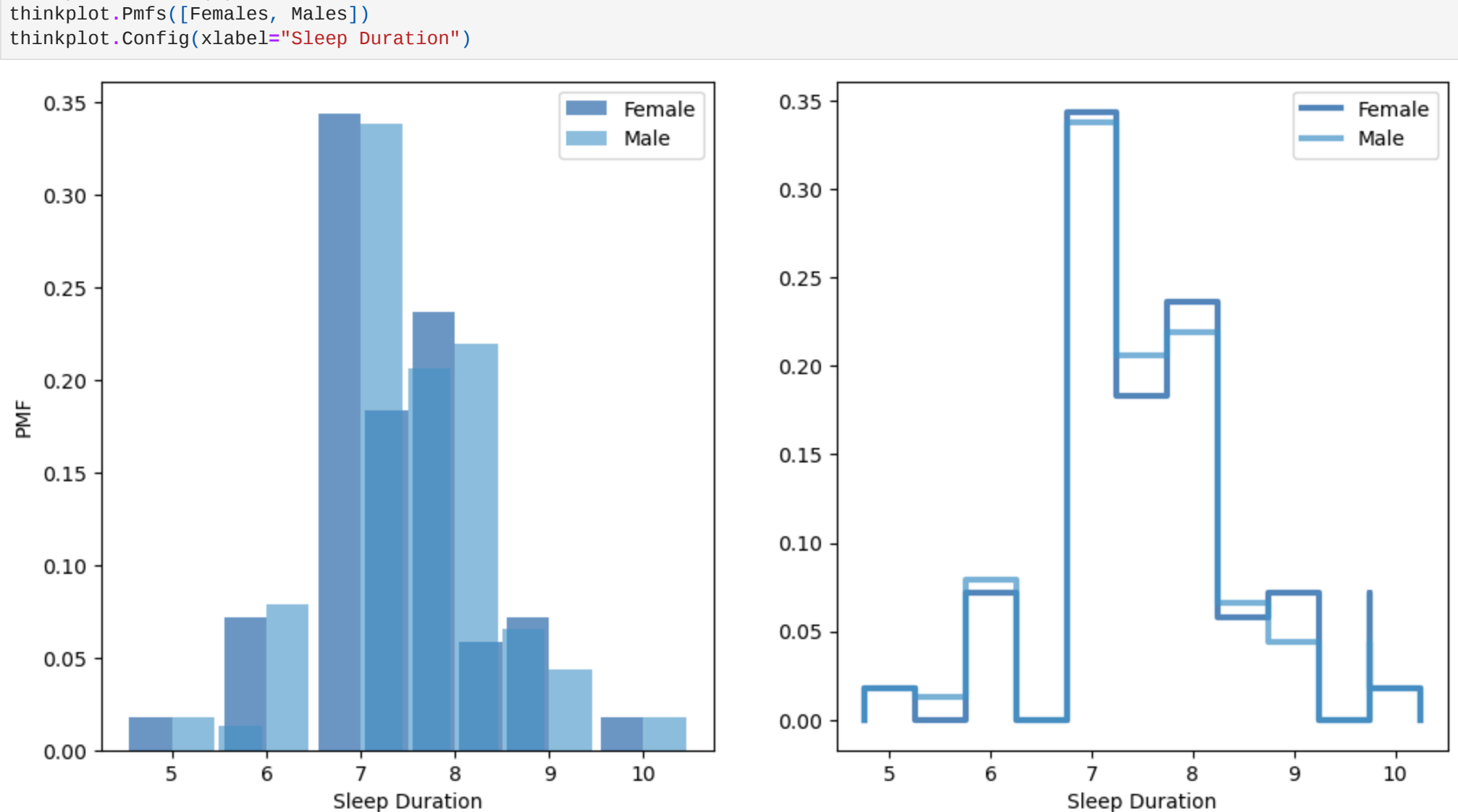



```
Mean: 52.823008849557525
<Figure size 800x600 with 0 Axes>
```

2 Scenarios with PMF: Scenario is Males Vs Females Sleep Duration

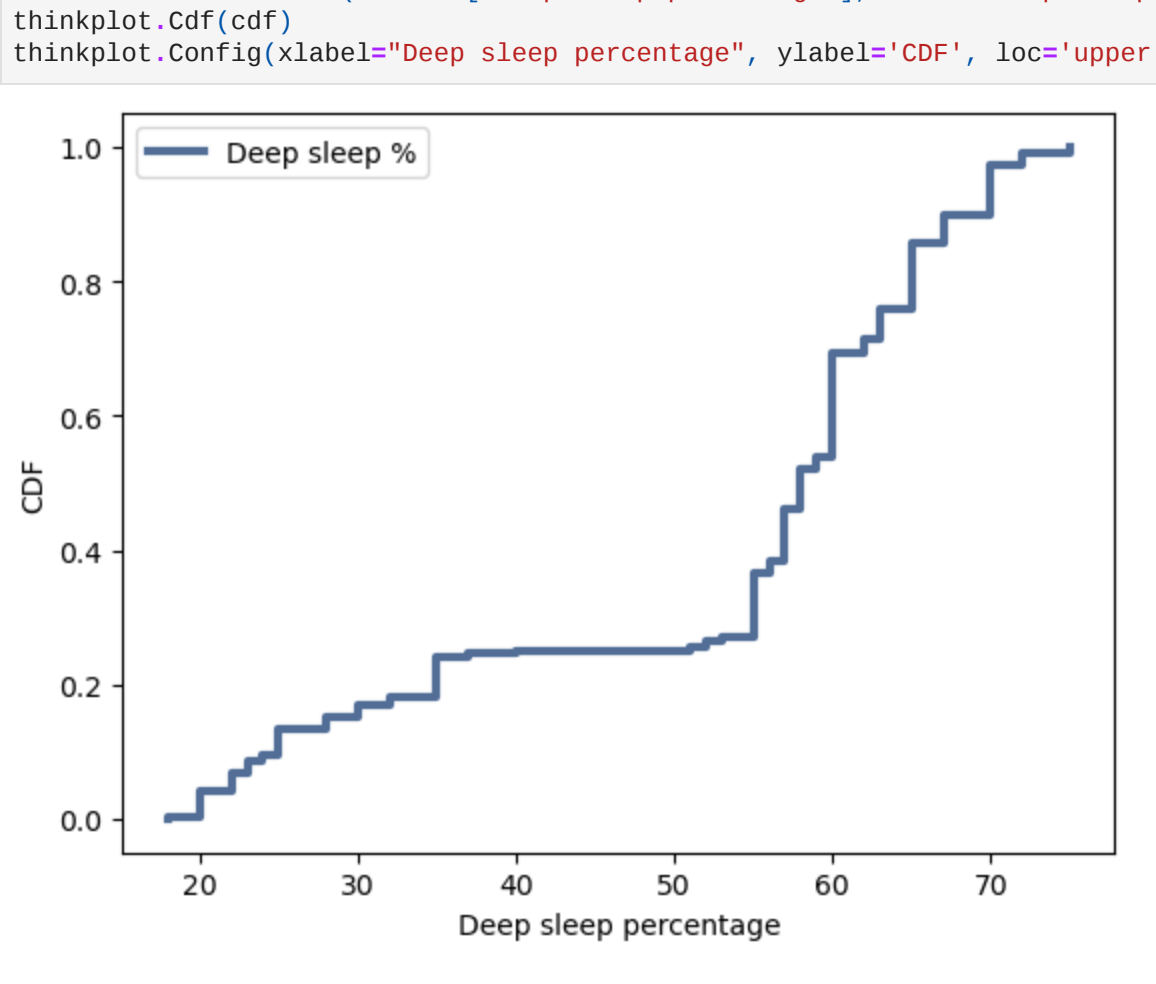
In [11]:
```
dataset1 = dataset[dataset['Gender'] == 'Female']
dataset2 = dataset[dataset['Gender'] == 'Male']
```

In [12]:
```
Females = thinkstats2.Pmf(dataset1["Sleep duration"], label="Female")
Males = thinkstats2.Pmf(dataset2["Sleep duration"], label="Male")

thinkplot.PrePlot(2, cols=2)
thinkplot.Hist(Females, align="right")
thinkplot.Hist(Males, align="left")
thinkplot.Config(xlabel="Sleep Duration", ylabel="PMF")

thinkplot.PrePlot(2)
thinkplot.SubPlot(2)
thinkplot.Pmfs([Females, Males])
thinkplot.Config(xlabel="Sleep Duration")
```



CDF with One of my variables: I chose deep sleep percentage to show the significance of this variable.

In [13]:
```
cdf = thinkstats2.Cdf(dataset["Deep sleep percentage"], label='Deep sleep %')
thinkplot.Cdf(cdf)
thinkplot.Config(xlabel="Deep sleep percentage", ylabel='CDF', loc='upper left')
```



In [14]:
```
cdf.Prob(50)
```

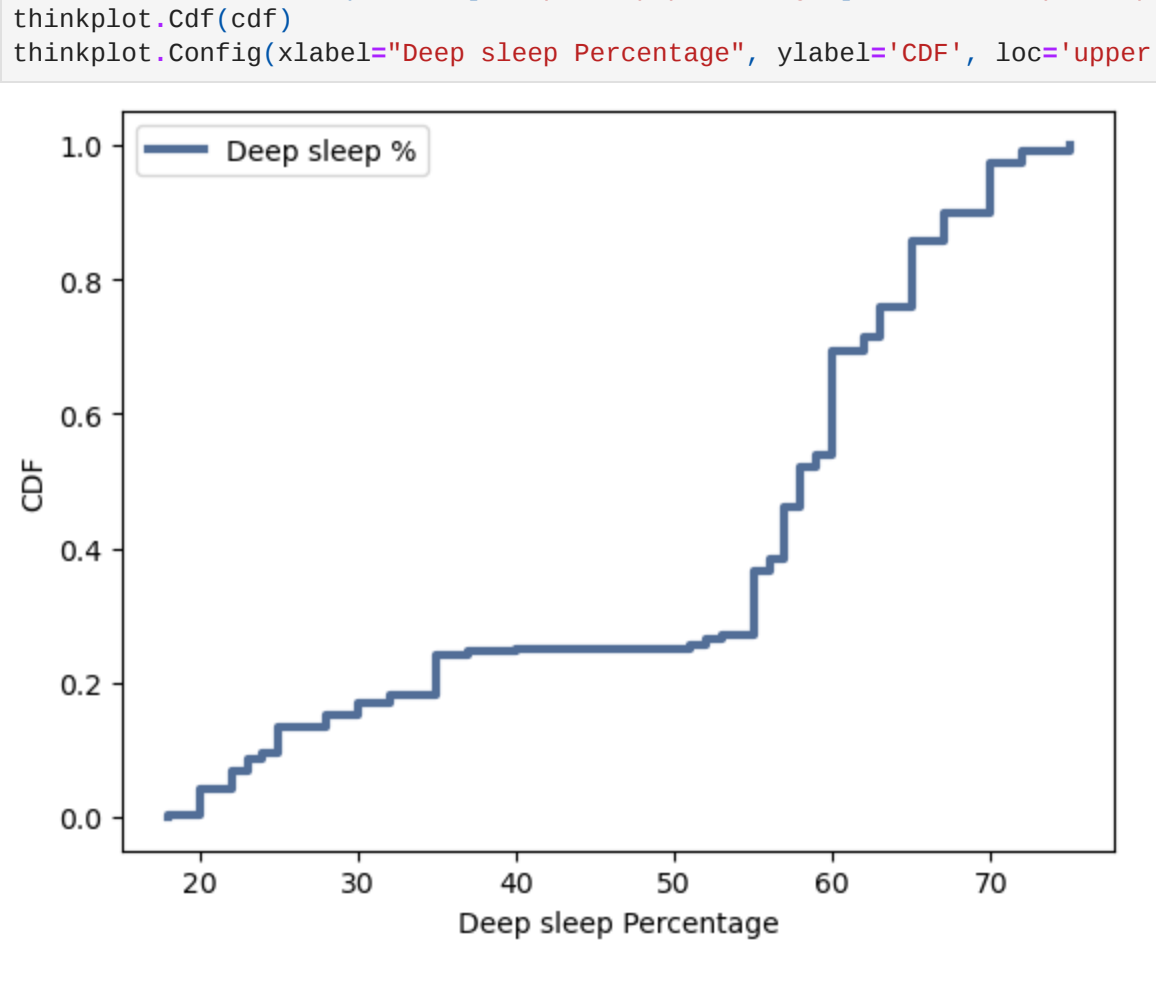
Out[14]:
```
0.25
```

Only 25% of sleeps have a deep sleep percentage of less than or equal to 50% (Top)

Analytical Distribution: Plotting the complementary CDF and Lognormal Distribution of Deep Sleep (Bottom)

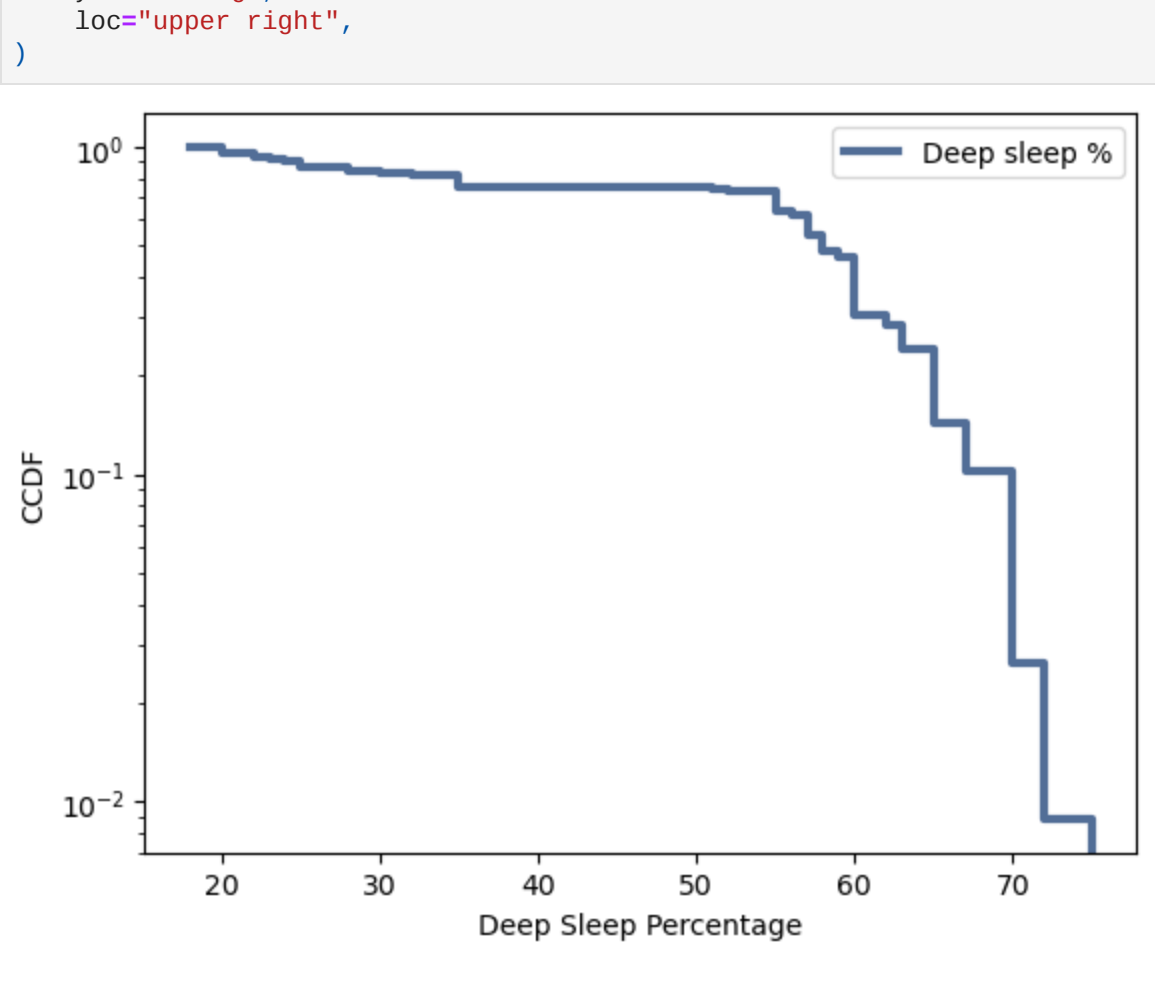
First a normal CDF Curve

In [15]:
```
cdf = thinkstats2.Cdf(dataset["Deep sleep percentage"], label='Deep sleep %')
thinkplot.Cdf(cdf)
thinkplot.Config(xlabel="Deep sleep Percentage", ylabel='CDF', loc='upper left')
```



Next is the Complementary CDF

In [16]:
```
thinkplot.Cdf(cdf, complement=True)
thinkplot.Config(
    xlabel="Deep Sleep Percentage",
    ylabel="CCDF",
    yscale="log",
    loc="upper right",
)
```



Lognormal Distribution Curve

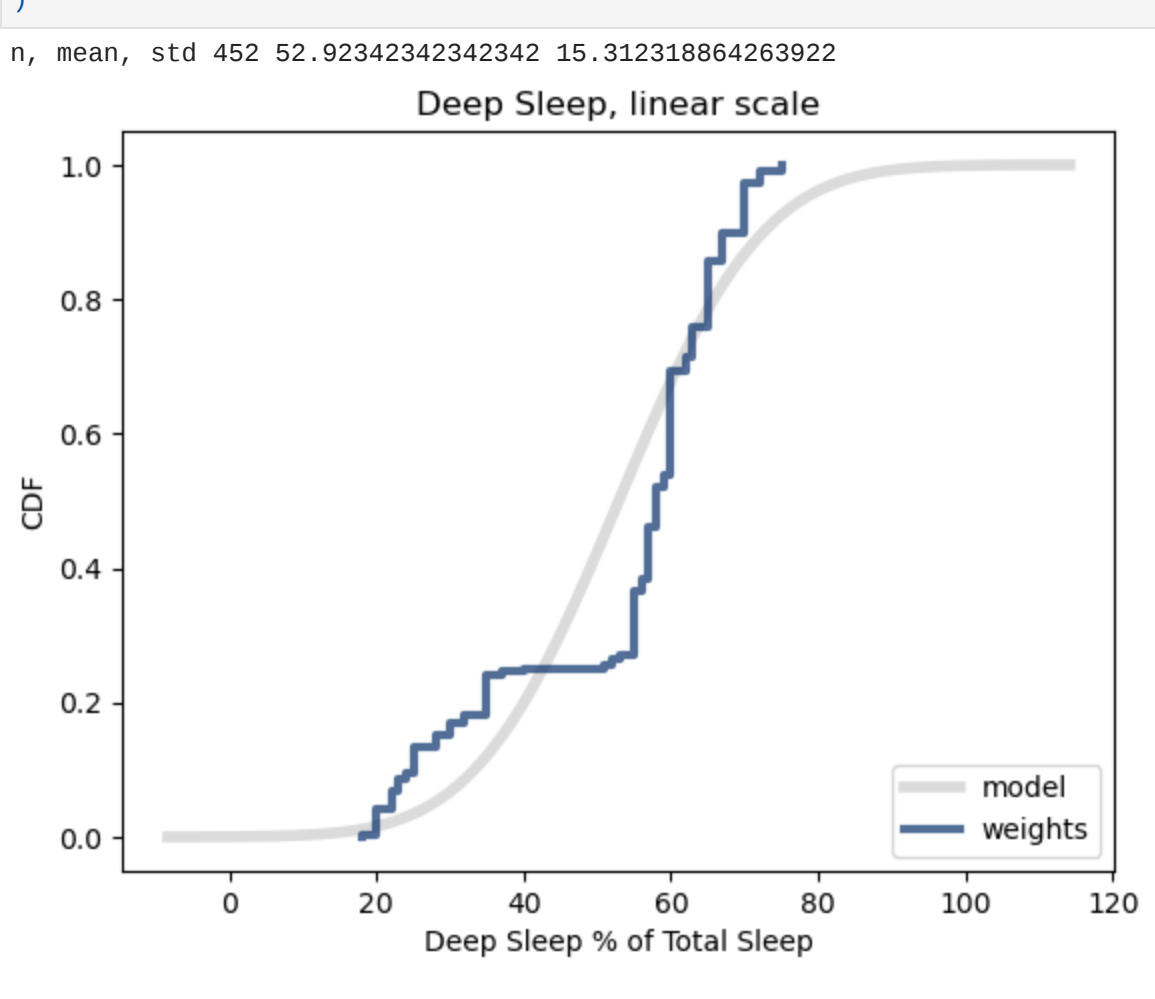
In [17]:
```
DeepSleep = dataset["Deep sleep percentage"]
SleepDuration = dataset["Sleep duration"]
REMSleep = dataset["REM sleep percentage"]
```

In [18]:
```
def MakeNormalModel(DeepSleep):
    """Plots a CDF with a Normal model.

    weights: sequence
    """
    cdf = thinkstats2.Cdf(DeepSleep, label="weights")

    mean, var = thinkstats2.TrimmedMeanVar(DeepSleep)
    std = np.sqrt(var)
    print("n, mean, std", len(DeepSleep), mean, std)

    xmin = mean - 4 * std
    xmax = mean + 4 * std

    xs, ps = thinkstats2.RenderNormalCdf(mean, std, xmin, xmax)
    thinkplot.Plot(xs, ps, label="model", linewidth=4, color="0.8")
    thinkplot.Cdf(cdf)
```

Linear Scale

In [19]:
```
MakeNormalModel(DeepSleep)
thinkplot.Config(
    title="Deep Sleep, linear scale",
    xlabel="Deep Sleep % of Total Sleep",
    ylabel="CDF",
    loc="lower right",
)
```

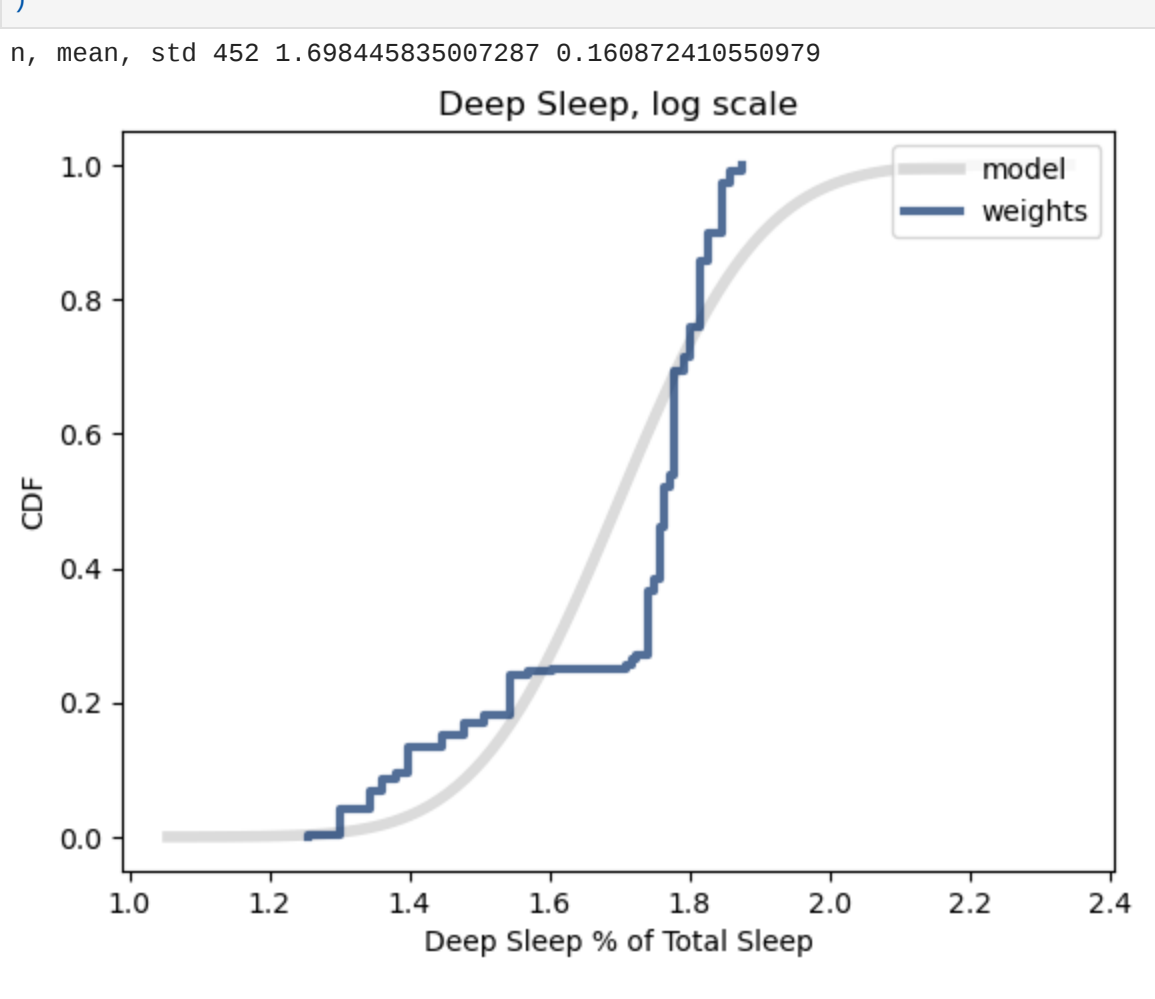
```
n, mean, std 452 52.92342342342342 15.312318864263922
```



Log Scale

In [20]:
```
log_DeepSleep = np.log10(DeepSleep)
MakeNormalModel(log_DeepSleep)
thinkplot.Config(
    title="Deep Sleep, log scale",
    xlabel="Deep Sleep % of Total Sleep",
    ylabel="CDF",
    loc="upper right",
)
```

```
n, mean, std 452 1.698445835007287 0.160872410550979
```



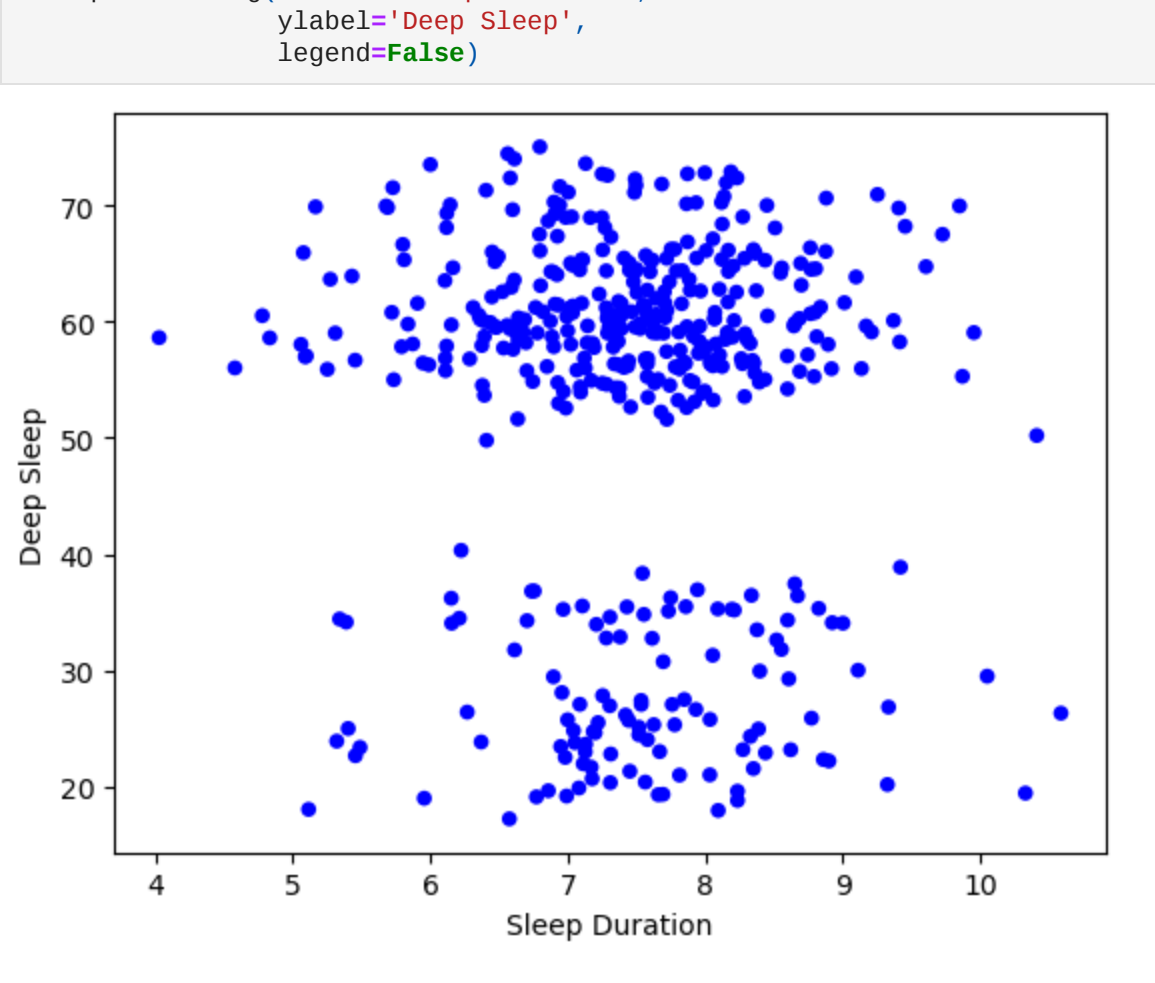
ScatterPlots Comparing 2 variables: Sleep Duration and Deep Sleep - Sleep Duration and REM Sleep %

In [21]:
```
def Jitter(values, jitter=0.5):
    n = len(values)
    return np.random.normal(0, jitter, n) + values
```

In [22]:
```
DeepSleep = Jitter(DeepSleep, 1.3)
SleepDuration = Jitter(SleepDuration, 0.5)
REMSleep  = Jitter(REMSleep , 0.7)
```

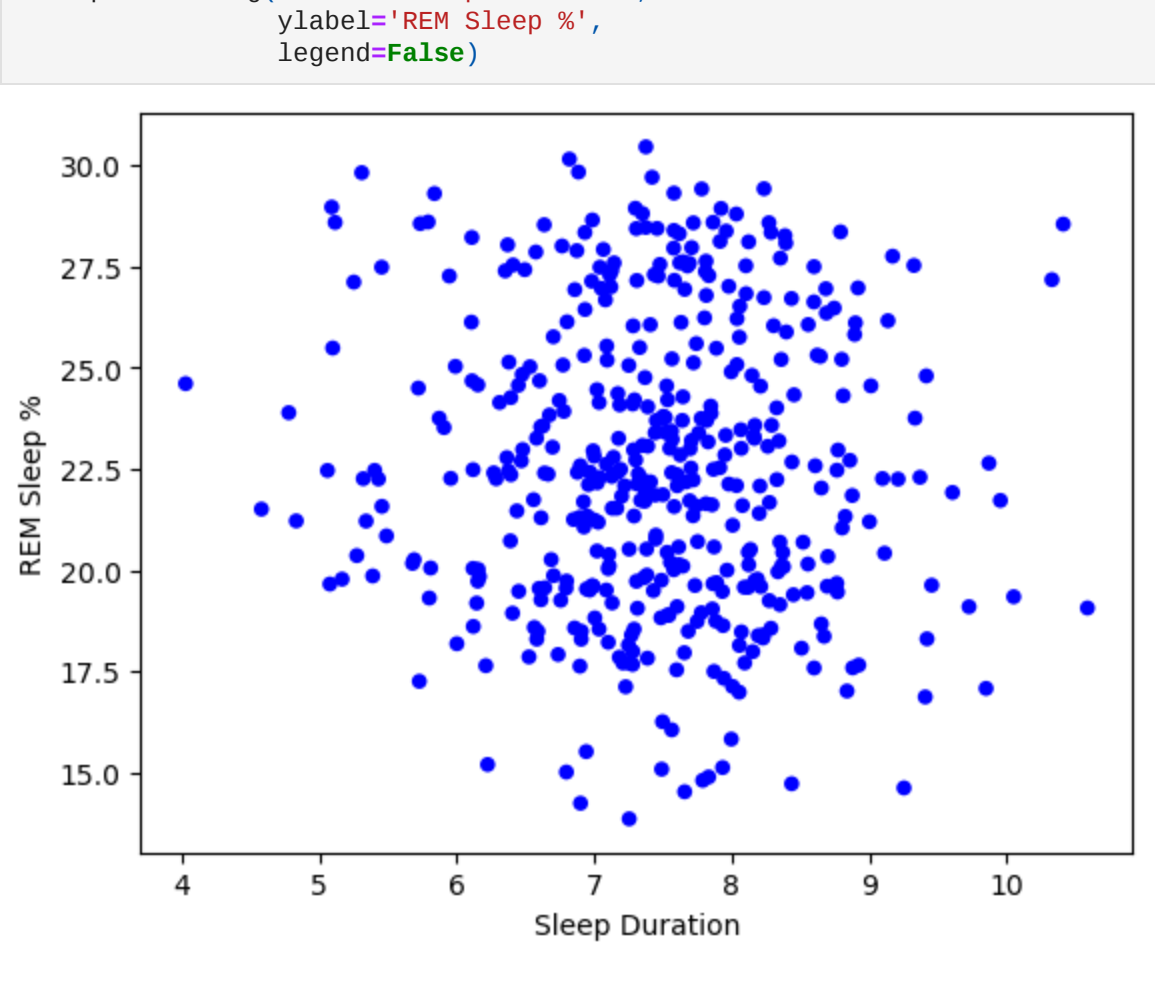
Sleep Duration vs Deep Sleep

In [23]:
```
thinkplot.Scatter(SleepDuration, DeepSleep, alpha=1.0)
thinkplot.Config(xlabel='Sleep Duration',
                 ylabel='Deep Sleep',
                 legend=False)
```



Sleep Duration vs REM Sleep %

In [24]:
```
thinkplot.Scatter(SleepDuration, REMSleep , alpha=1.0)
thinkplot.Config(xlabel='Sleep Duration',
                 ylabel='REM Sleep %',
                 legend=False)
```



Conducting a test on my hypothesis:

In [25]:
```
class HypothesisTest(object):

    def __init__(self, data):
        self.data = data
        self.MakeModel()
        self.actual = self.TestStatistic(data)

    def PValue(self, iters=1000):
        self.test_stats = [self.TestStatistic(self.RunModel())
                           for _ in range(iters)]

        count = sum(1 for x in self.test_stats if x >= self.actual)
        return count / iters

    def TestStatistic(self, data):
        raise UnimplementedMethodException()

    def MakeModel(self):
        pass

    def RunModel(self):
        raise UnimplementedMethodException()
```

In [26]:
```
class CorrelationPermute(thinkstats2.HypothesisTest):

    def TestStatistic(self, data):
        xs, ys = data
        test_stat = abs(thinkstats2.Corr(xs, ys))
        return test_stat

    def RunModel(self):
        xs, ys = self.data
        xs = np.random.permutation(xs)
        return xs, ys
```

In [32]:
```
data = SleepDuration, DeepSleep
HypoTest = CorrelationPermute(data)
pvalue = HypoTest.PValue()
pvalue
```

Out[32]:
```
0.213
```

In [28]:
```
def LeastSquares(xs, ys):
    meanx, varx = MeanVar(xs)
    meany = Mean(ys)

    slope = Cov(xs, ys, meanx, meany) / varx
    inter = meany - slope * meanx

    return inter, slope
```

In [29]:
```
LeastSquares(SleepDuration, DeepSleep)
```

Out[29]:
```
(59.804881819889594, -0.9263574429639483)
```

In [ ]: