In [3]:
```
import scipy.stats as st
import nsfg
import numpy as np
import matplotlib.pyplot as plt
import thinkstats2
import math
import thinkplot
import pandas as pd
import random
import statsmodels.formula.api as smf
```

In [4]:
```
#read fantasy data into data frames
df16 = pd.read_excel('fantasyfootballweekly16.xlsx')

# Show the first few rows of the dataframe to check the data
df16.head()
```

Out[4]:

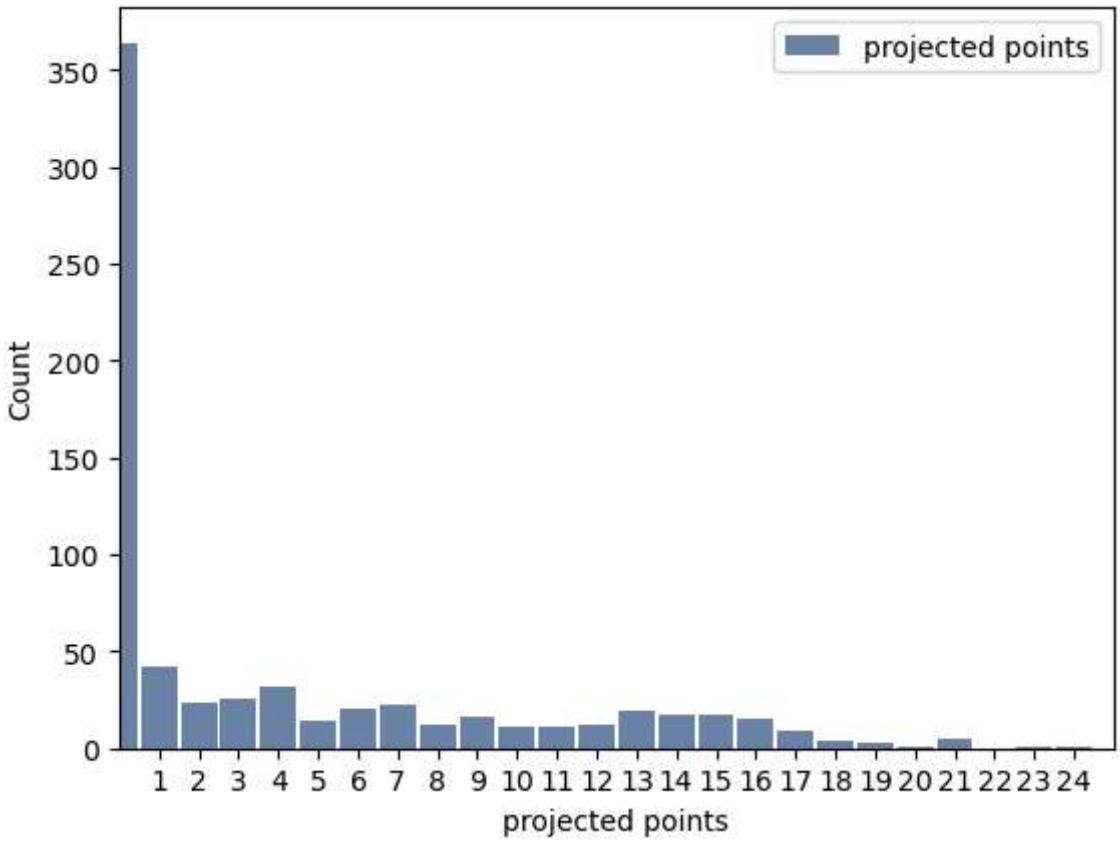
	Unnamed: 0	PLAYER NAME	PLAYER TEAM	PLAYER POSITION	OPP	STATUS	PROJ	ROUNDPROJ	PASSING C/A	PASSING YDS	...
0	0	Amari Cooper	Cle	WR	@Hou	W 36-22	13.3	13.0	0/0	0	...
1	1	Breece Hall	NYJ	RB	Wsh	W 30-28	16	16.0	0/0	0	...
2	2	George Pickens	Pit	WR	Cin	W 34-11	9.8	10.0	0/0	0	...
3	5	DJ Chark Jr.	Car	WR	GB	L 30-33	6.1	6.0	0/0	0	...
4	3	Puka Nacua	LAR	WR	NO	W 30-22	14	14.0	0/0	0	...

5 rows × 28 columns

In [5]:
```
df2 = pd.read_excel('fantasyfootballweekly2.xlsx')
df3 = pd.read_excel('fantasyfootballweekly3.xlsx')
df4 = pd.read_excel('fantasyfootballweekly4.xlsx')
df5 = pd.read_excel('fantasyfootballweekly5.xlsx')
df6 = pd.read_excel('fantasyfootballweekly6.xlsx')
df7 = pd.read_excel('fantasyfootballweekly7.xlsx')
df8 = pd.read_excel('fantasyfootballweekly8.xlsx')
df9 = pd.read_excel('fantasyfootballweekly9.xlsx')
df10 = pd.read_excel('fantasyfootballweekly10.xlsx')
df11 = pd.read_excel('fantasyfootballweekly11.xlsx')
df12 = pd.read_excel('fantasyfootballweekly12.xlsx')
df13 = pd.read_excel('fantasyfootballweekly13.xlsx')
df14 = pd.read_excel('fantasyfootballweekly14.xlsx')
df15 = pd.read_excel('fantasyfootballweekly15.xlsx')
df17 = pd.read_excel('fantasyfootballweekly17.xlsx')
df18 = pd.read_excel('fantasyfootballweekly18.xlsx')
```

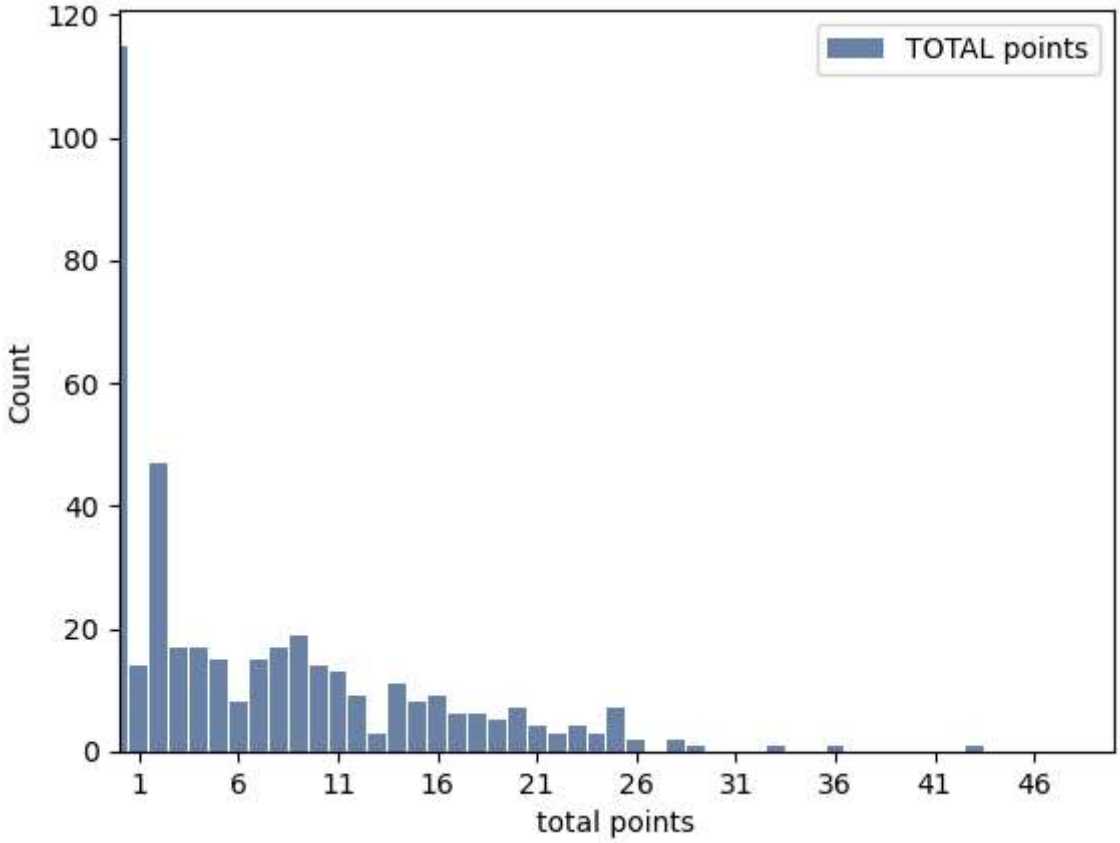
In [ ]:

In [7]:
```
hist = thinkstats2.Hist(df16.ROUNDPROJ, label='projected points')
thinkplot.Hist(hist)
plt.xlim(0, 25)
plt.xticks(range(1, 25))
thinkplot.Config(xlabel='projected points', ylabel='Count')
```



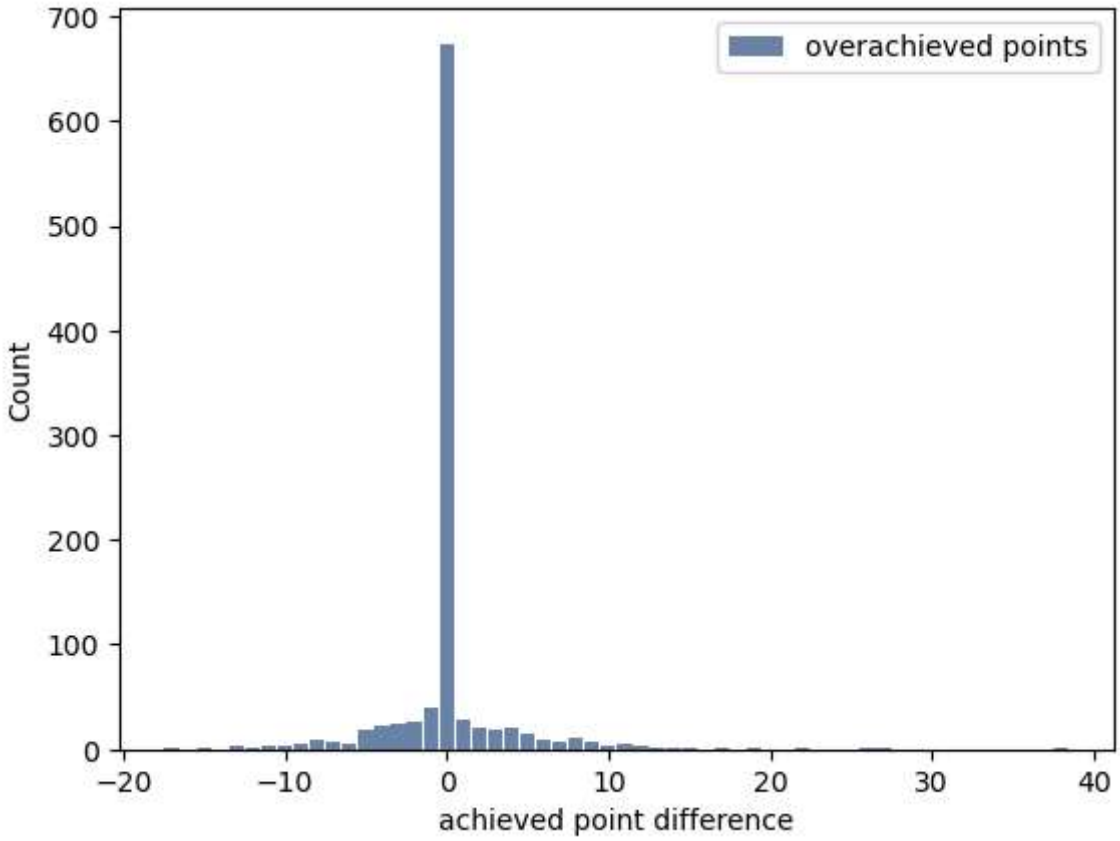
In [8]:
```
#shows that a lot of people are projected 0 points meaning that they aren't playing
#we will want to get rid of those so that the data doesn't get ruined
```

In [9]:
```
hist = thinkstats2.Hist(df16.ROUNDTOTAL, label='TOTAL points')
thinkplot.Hist(hist)
plt.xlim(0, 50)
plt.xticks(range(1, 50, 5))
thinkplot.Config(xlabel='total points', ylabel='Count')
```



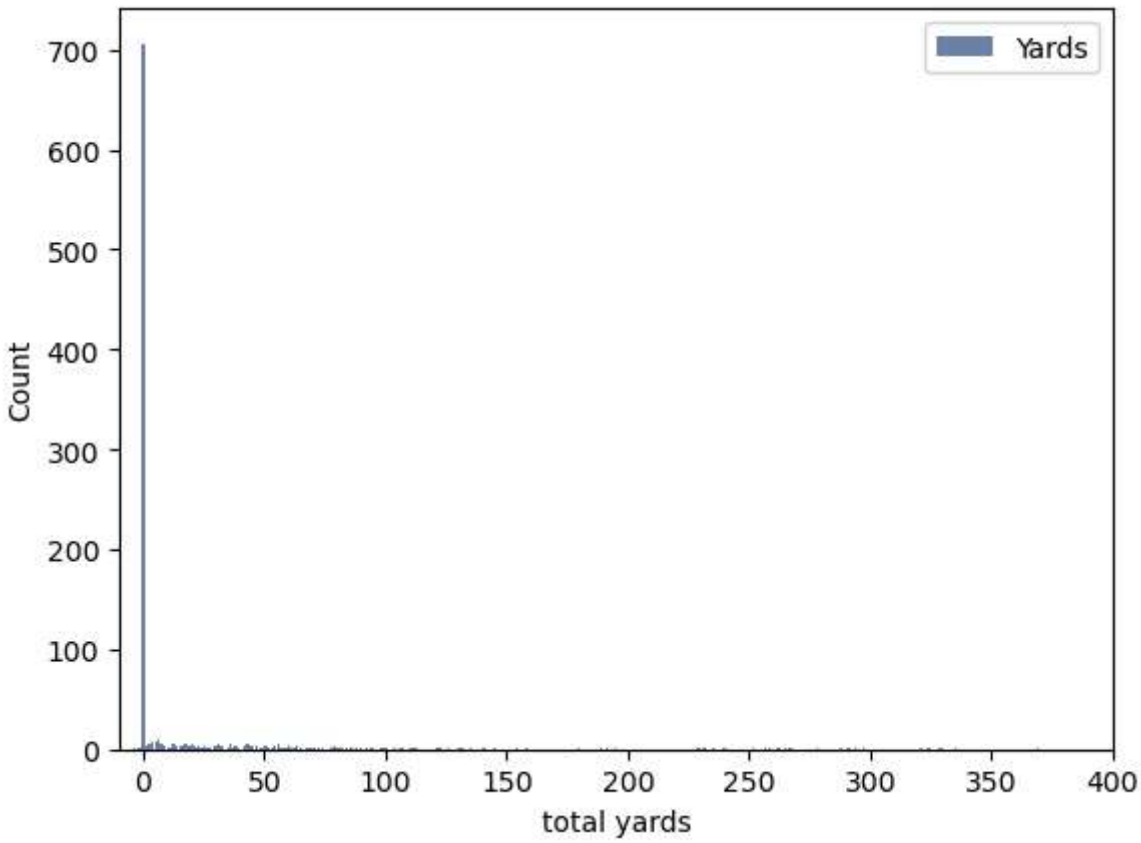
In [10]:
```
#similarly, many people achieved 0 points. If players are projected and received 0 points they sh
```

In [11]:
```
hist = thinkstats2.Hist(df16.ROUNDOVER, label='overachieved points')
thinkplot.Hist(hist)
thinkplot.Config(xlabel='achieved point difference', ylabel='Count')
```



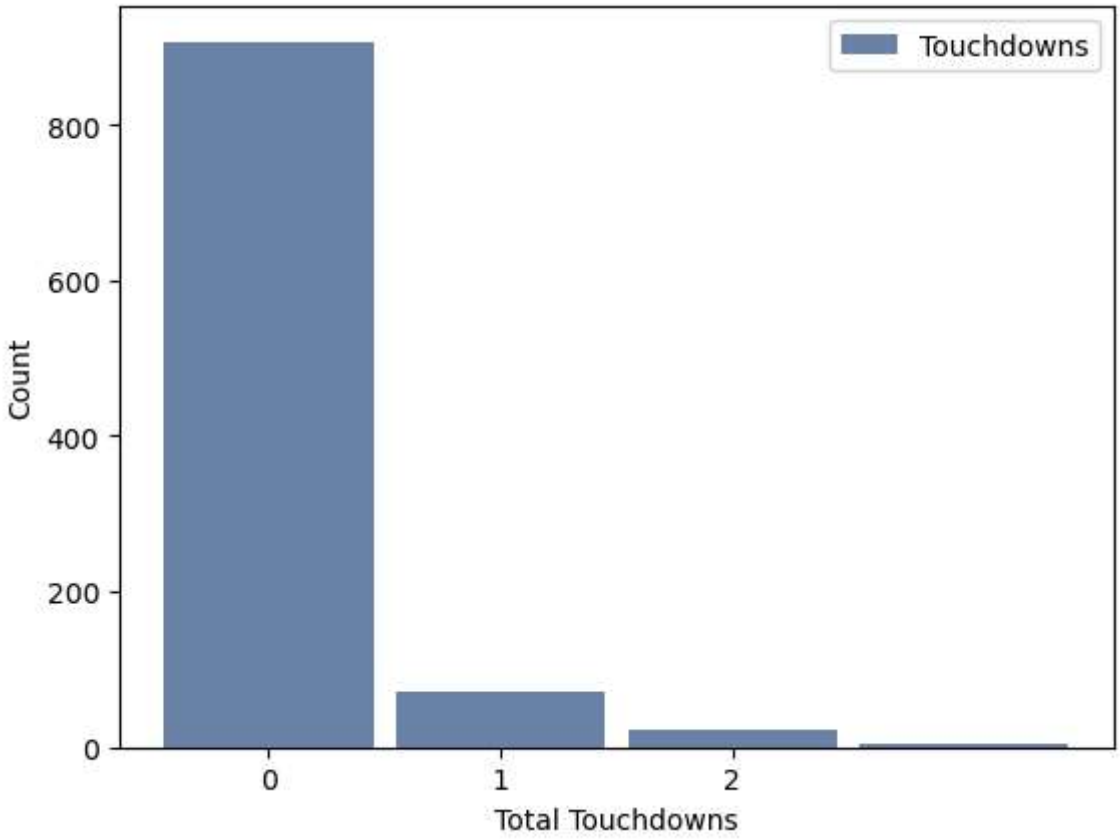
In [12]:
```
#There seems to be few people who overachieved predicted points by almost 40 and some who underac
#many of the 0s seems to be from people who were projected and received 0 points
```

In [15]:
```
hist = thinkstats2.Hist(df16.TOTALYARDS, label='Yards')
thinkplot.Hist(hist)
plt.xlim(-10, 400)
thinkplot.Config(xlabel='total yards', ylabel='Count')
```



In [16]:
```
#some players got near 400 yards (either receiving, passing or rushing)
#most of the players with 0 were projected 0 as seen in previous histograms, which skews the dat
```

In [17]:
```
hist = thinkstats2.Hist(df16.TOUCHDOWNS, label='Touchdowns')
thinkplot.Hist(hist)
plt.xticks(range(0, 3))
thinkplot.Config(xlabel='Total Touchdowns', ylabel='Count')
```



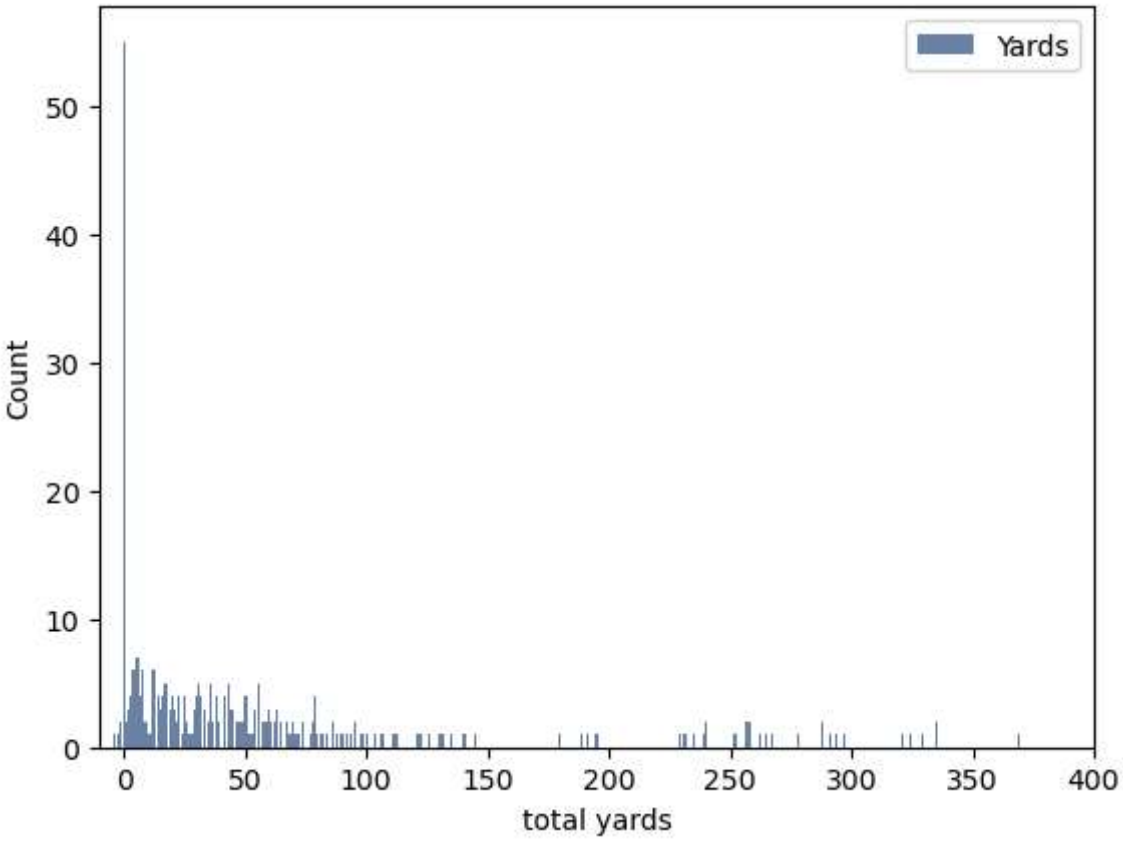
In [18]:
```
#as expected, most players received 0 touchdowns and the least amount of players received 3
#3 was the maximum number of touchdowns any players achieved
```

In [19]:
```
#create histogram that does not include players who did not play
```

In [20]:
```
activeproj = df16[df16['ROUNDPROJ'] > 0]
```

In [21]:
```
activeplayers = activeproj.dropna()
```

In [22]:
```
#checking how the total yards histogram changes with inactive players removed
hist = thinkstats2.Hist(activeplayers.TOTALYARDS, label='Yards')
thinkplot.Hist(hist)
plt.xlim(-10, 400)
thinkplot.Config(xlabel='total yards', ylabel='Count')
```



In [130…
```
#split active players based on wr or not positions
wr = activeplayers[activeplayers['PLAYER POSITION'] == 'WR']
not_wr = activeplayers[activeplayers['PLAYER POSITION'] != 'WR']
```

In [132…
```
#compute mean mode spread and tails of wide receivers
```

In [134…
```
#mean
wr['TOUCHDOWNS'].mean()
```

Out[134…
```
0.25
```

In [138…
```
#mean
wr['TOTALYARDS'].mean()
```

Out[138…
```
37.378571428571426
```

In [142…
```
#mean
wr['ROUNDOVER'].mean()
```

Out[142…
```
0.39285714285714285
```

In [146…
```
#mean
wr['ROUNDTOTAL'].mean()
```

Out[146…
```
7.978571428571429
```

In [150…
```
#mean
wr['ROUNDPROJ'].mean()
```

Out[150…
```
7.571428571428571
```

In [136…
```
#mean
not_wr['TOUCHDOWNS'].mean()
```

Out[136… 0.453125

In [140…
```
#mean
not_wr['TOTALYARDS'].mean()
```

Out[140… 70.390625

In [144…
```
#mean
not_wr['ROUNDOVER'].mean()
```

Out[144… 0.015625

In [148…
```
#mean
not_wr['ROUNDTOTAL'].mean()
```

Out[148… 8.432291666666666

In [152…
```
#mean
not_wr['ROUNDPROJ'].mean()
```

Out[152… 8.458333333333334

In [154…
```
##########################################################################################
```

In [156…
```
#mode
wr['TOUCHDOWNS'].mode()
```

Out[156…
```
0    0
Name: TOUCHDOWNS, dtype: int64
```

In [160…
```
#mode
wr['TOTALYARDS'].mode()
```

Out[160…
```
0    0
Name: TOTALYARDS, dtype: int64
```

In [164…
```
#mode
wr['ROUNDOVER'].mode()
```

Out[164…
```
0   -3
Name: ROUNDOVER, dtype: int64
```

In [168…
```
#mode
wr['ROUNDTOTAL'].mode()
```

Out[168…
```
0    0.0
Name: ROUNDTOTAL, dtype: float64
```

In [172…
```
#mode
wr['ROUNDPROJ'].mode()
```

Out[172…
```
0    3.0
Name: ROUNDPROJ, dtype: float64
```

In [158…
```
#mode
not_wr['TOUCHDOWNS'].mode()
```

Out[158…
```
0    0
Name: TOUCHDOWNS, dtype: int64
```

In [162…
```
#mode
not_wr['TOTALYARDS'].mode()
```

Out[162…
```
0    0
Name: TOTALYARDS, dtype: int64
```

In [166…
```
#mode
not_wr['ROUNDOVER'].mode()
```

Out[166…
```
0   -1
Name: ROUNDOVER, dtype: int64
```

In [170…
```
#mode
not_wr['ROUNDTOTAL'].mode()
```

Out[170…
```
0    0.0
Name: ROUNDTOTAL, dtype: float64
```

In [174…
```
#mode
not_wr['ROUNDPROJ'].mode()
```

Out[174…
```
0    1.0
Name: ROUNDPROJ, dtype: float64
```

In [176…
```
################################################################
```

In [180…
```
#spread for wr
wr['TOUCHDOWNS'].max() - wr['TOUCHDOWNS'].min()
```

Out[180…
```
2
```

In [184…
```
#spread
wr['TOTALYARDS'].max() - wr['TOTALYARDS'].min()
```

Out[184…
```
266
```

In [188…
```
#spread
wr['ROUNDOVER'].max() - wr['ROUNDOVER'].min()
```

Out[188…
```
53
```

In [192…
```
#spread
wr['ROUNDTOTAL'].max() - wr['ROUNDTOTAL'].min()
```

Out[192…
```
54.0
```

In [196…
```
#spread
wr['ROUNDPROJ'].max() - wr['ROUNDPROJ'].min()
```

Out[196…
```
22.0
```

In [178…
```
#spread for all other active players
not_wr['TOUCHDOWNS'].max() - not_wr['TOUCHDOWNS'].min()
```

Out[178…
```
3
```

In [182…
```
#spread
not_wr['TOTALYARDS'].max() - not_wr['TOTALYARDS'].min()
```

Out[182… 416

In [186…
```
#spread
not_wr['ROUNDOVER'].max() - not_wr['ROUNDOVER'].min()
```

Out[186… 44

In [190…
```
#spread
not_wr['ROUNDTOTAL'].max() - not_wr['ROUNDTOTAL'].min()
```

Out[190… 45.0

In [194…
```
#spread
not_wr['ROUNDPROJ'].max() - not_wr['ROUNDPROJ'].min()
```

Out[194… 23.0

In [198…
```
################################################################
```

In [200…
```
#tails
lower_tail = np.percentile(not_wr['TOUCHDOWNS'], 5)
upper_tail = np.percentile(not_wr['TOUCHDOWNS'], 95)
print(lower_tail)
print(upper_tail)
```

```
0.0
2.0
```

In [204…
```
#tails
lower_tail = np.percentile(not_wr['TOTALYARDS'], 5)
upper_tail = np.percentile(not_wr['TOTALYARDS'], 95)
print(lower_tail)
print(upper_tail)
```

```
0.0
289.34999999999997
```

In [208…
```
#tails
lower_tail = np.percentile(not_wr['ROUNDOVER'], 5)
upper_tail = np.percentile(not_wr['ROUNDOVER'], 95)
print(lower_tail)
print(upper_tail)
```

```
-9.0
9.0
```

In [212…
```
#tails
lower_tail = np.percentile(not_wr['ROUNDTOTAL'], 5)
upper_tail = np.percentile(not_wr['ROUNDTOTAL'], 95)
print(lower_tail)
print(upper_tail)
```

```
0.0
23.0
```

In [216…
```
#tails
lower_tail = np.percentile(not_wr['ROUNDPROJ'], 5)
upper_tail = np.percentile(not_wr['ROUNDPROJ'], 95)
print(lower_tail)
print(upper_tail)
```

```
1.0
18.0
```

In [202…
```
#tails
lower_tail = np.percentile(wr['TOUCHDOWNS'], 5)
upper_tail = np.percentile(wr['TOUCHDOWNS'], 95)
print(lower_tail)
print(upper_tail)
```

```
0.0
1.0
```

In [206…
```
#tails
lower_tail = np.percentile(wr['TOTALYARDS'], 5)
upper_tail = np.percentile(wr['TOTALYARDS'], 95)
print(lower_tail)
print(upper_tail)
```

```
0.0
123.34999999999988
```

In [210…
```
#tails
lower_tail = np.percentile(wr['ROUNDOVER'], 5)
upper_tail = np.percentile(wr['ROUNDOVER'], 95)
print(lower_tail)
print(upper_tail)
```

```
-8.05
12.049999999999983
```

In [214…
```
#tails
lower_tail = np.percentile(wr['ROUNDTOTAL'], 5)
upper_tail = np.percentile(wr['ROUNDTOTAL'], 95)
print(lower_tail)
print(upper_tail)
```

```
0.0
26.0
```

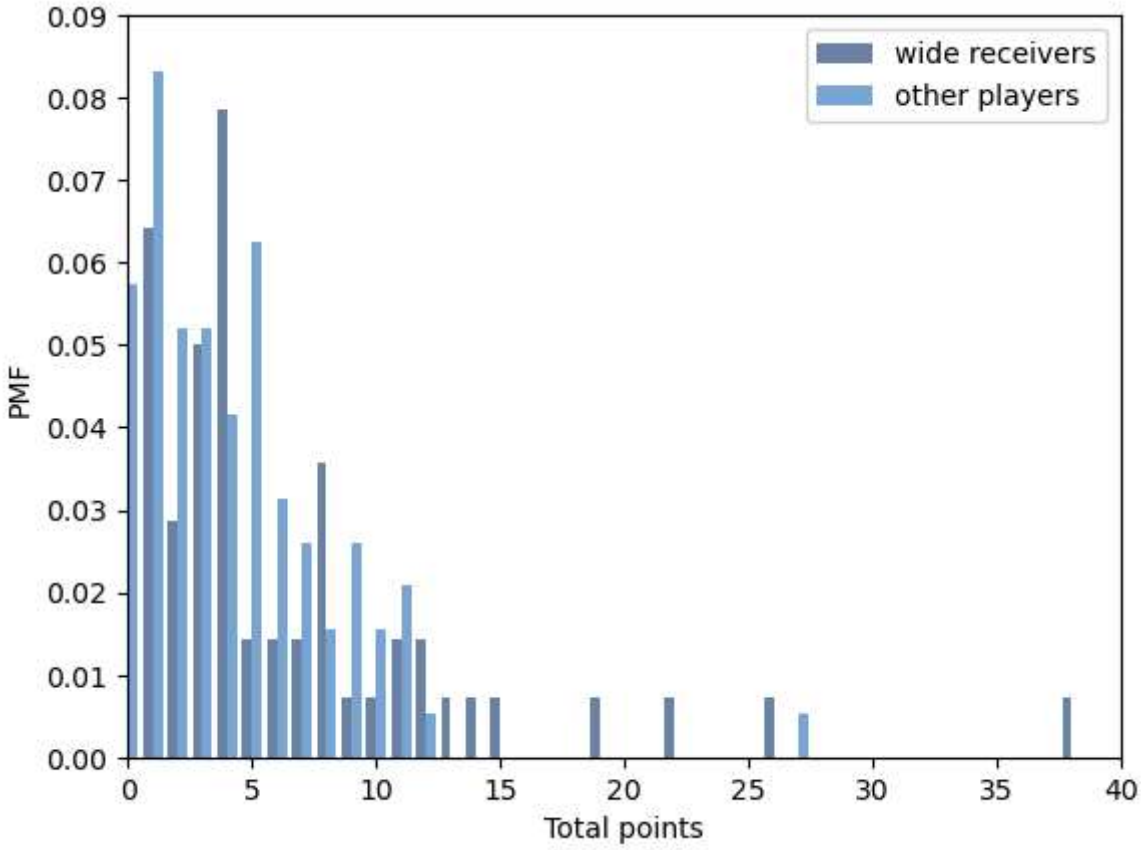
In [218…
```
#tails
lower_tail = np.percentile(wr['ROUNDPROJ'], 5)
upper_tail = np.percentile(wr['ROUNDPROJ'], 95)
print(lower_tail)
print(upper_tail)
```

```
1.0
17.0
```

In [220…
```
#############################################################
```

In [222…
```
wr_pmf = thinkstats2.Pmf(wr.ROUNDOVER, label="wide receivers")
not_wr_pmf = thinkstats2.Pmf(not_wr.ROUNDOVER, label="other players")
```

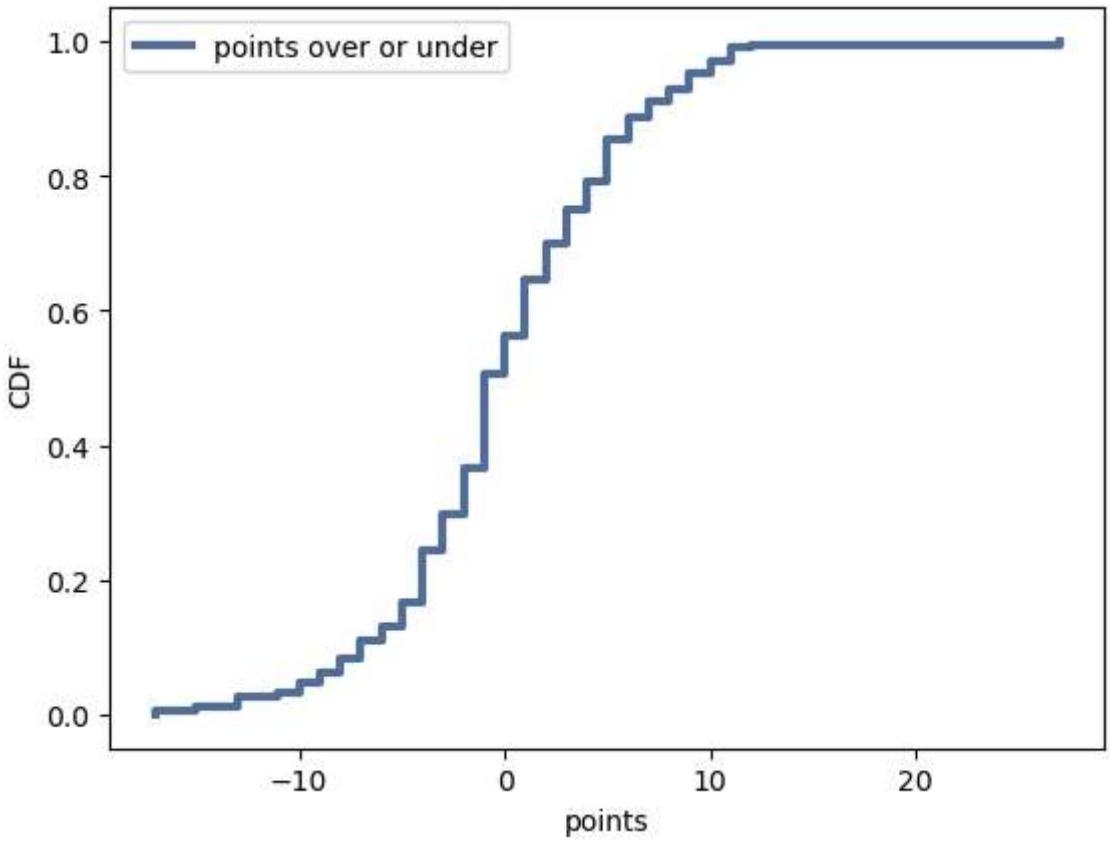
In [224…
```
width = 0.4
axis = [0, 40, 0, .09]
thinkplot.Hist(wr_pmf, align="right", width=width)
thinkplot.Hist(not_wr_pmf, align="left", width=width)
thinkplot.Config(xlabel="Total points", ylabel="PMF", axis=axis)
```



In [226…
```
#create a cdf for all other players
```

In [228…
```
cdf = thinkstats2.Cdf(not_wr.ROUNDOVER, label = 'points over or under')
```

In [230…
```
thinkplot.Cdf(cdf)
thinkplot.Show(xlabel='points', ylabel = 'CDF')
```

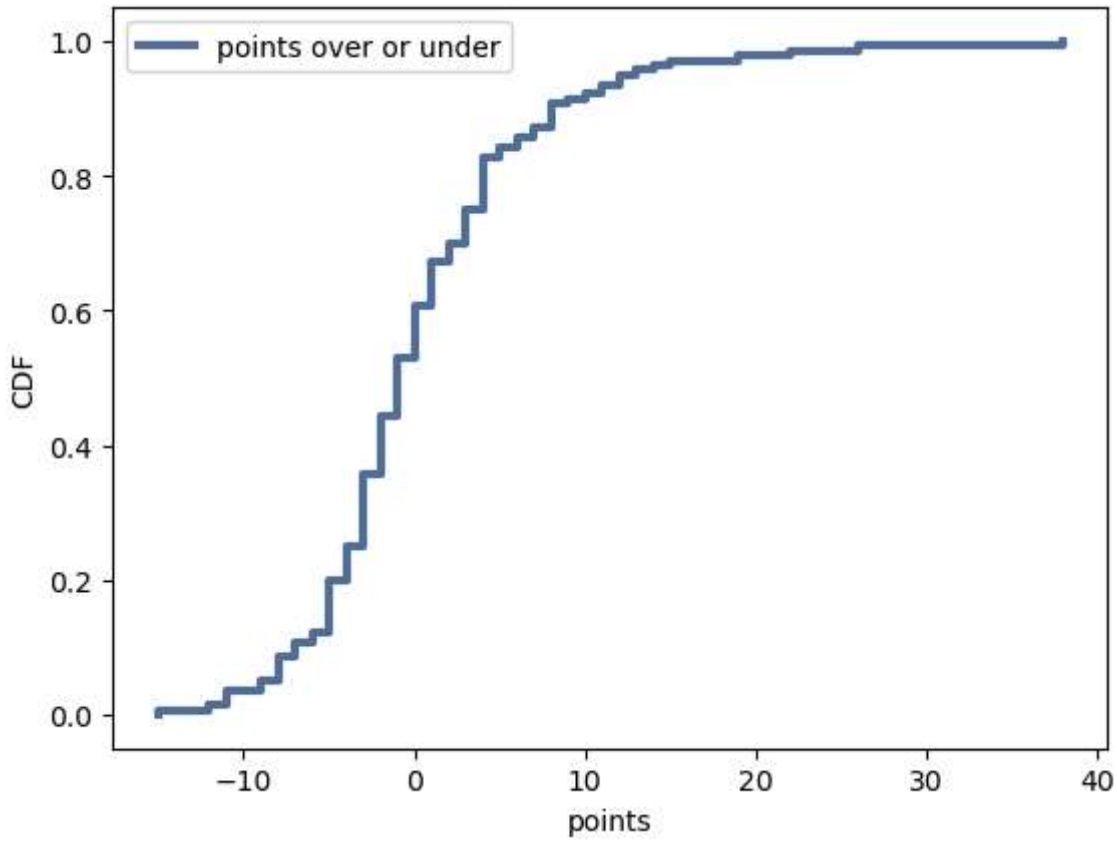



```
<Figure size 800x600 with 0 Axes>
```

In [354…
```
cdf.Prob(0)
```

Out[354…
```
0.5625
```

In [232…
```
#cdf for wide receivers
cdfwr = thinkstats2.Cdf(wr.ROUNDOVER, label = 'points over or under')
thinkplot.Cdf(cdfwr)
thinkplot.Show(xlabel='points', ylabel = 'CDF')
```




```
<Figure size 800x600 with 0 Axes>
```

In [352…
```
cdfwr.Prob(0)
```

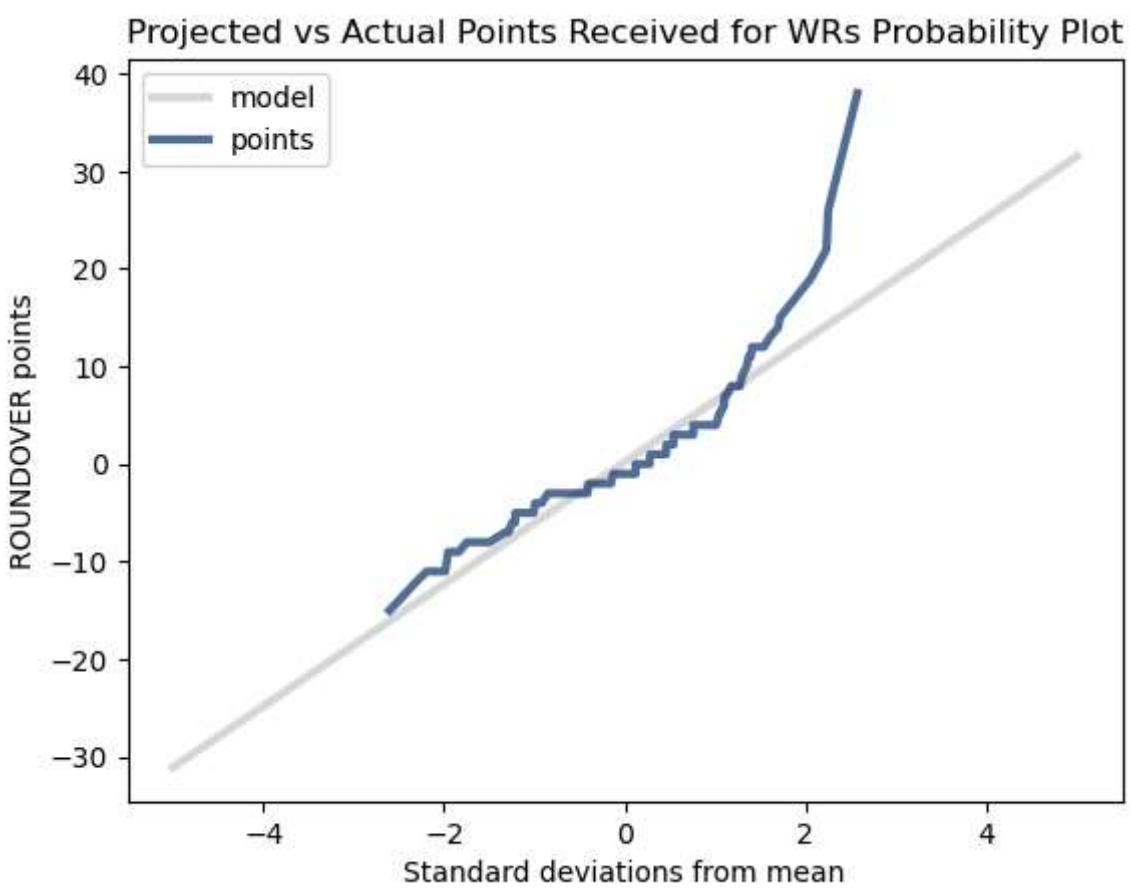
Out[352…
```
0.6071428571428571
```

In [102…
```
#normal distribution plot
```

In [234…
```
wr_roundover = wr.ROUNDOVER.dropna()
```

In [236…
```
def MakeNormalPlot(wr_roundover):
    mean, var = thinkstats2.TrimmedMeanVar(wr_roundover, p=0.01)
    std = np.sqrt(var)
    xs = [-5, 5]
    xs, ys = thinkstats2.FitLine(xs, mean, std)
    thinkplot.Plot(xs, ys, color="0.8", label="model")
    xs, ys = thinkstats2.NormalProbability(wr_roundover)
    thinkplot.Plot(xs, ys, label="points")
```

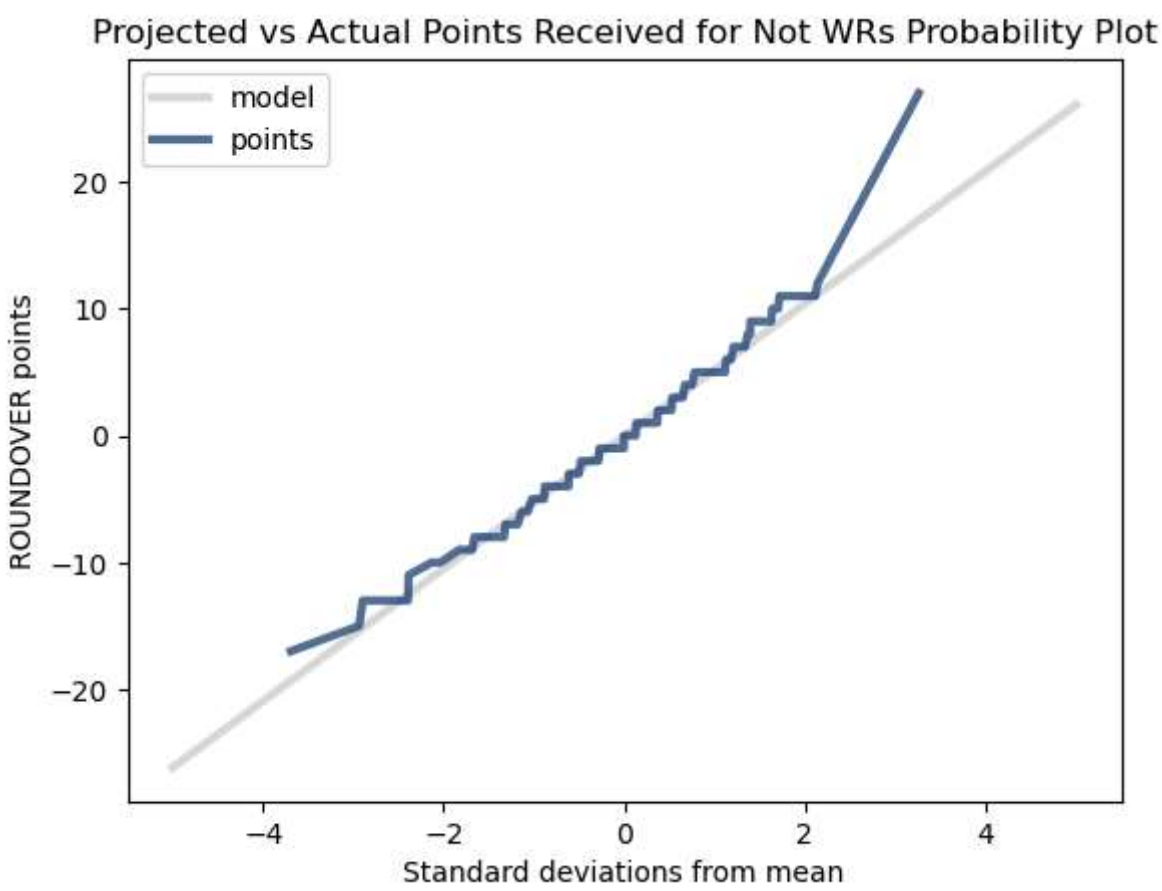
In [364…
```
MakeNormalPlot(wr_roundover)
thinkplot.Config(
    title="Projected vs Actual Points Received for WRs Probability Plot",
    xlabel="Standard deviations from mean",
    ylabel="ROUNDOVER points",
    loc="upper left")
```



In [250…
```
not_wr_roundover = not_wr.ROUNDOVER.dropna()
```

In [360…
```
def MakeNormalPlot(not_wr_roundover):
    mean, var = thinkstats2.TrimmedMeanVar(not_wr_roundover, p=0.01)
    std = np.sqrt(var)
    xs = [-5, 5]
    xs, ys = thinkstats2.FitLine(xs, mean, std)
    thinkplot.Plot(xs, ys, color="0.8", label="model")
    xs, ys = thinkstats2.NormalProbability(not_wr_roundover)
    thinkplot.Plot(xs, ys, label="points")
```

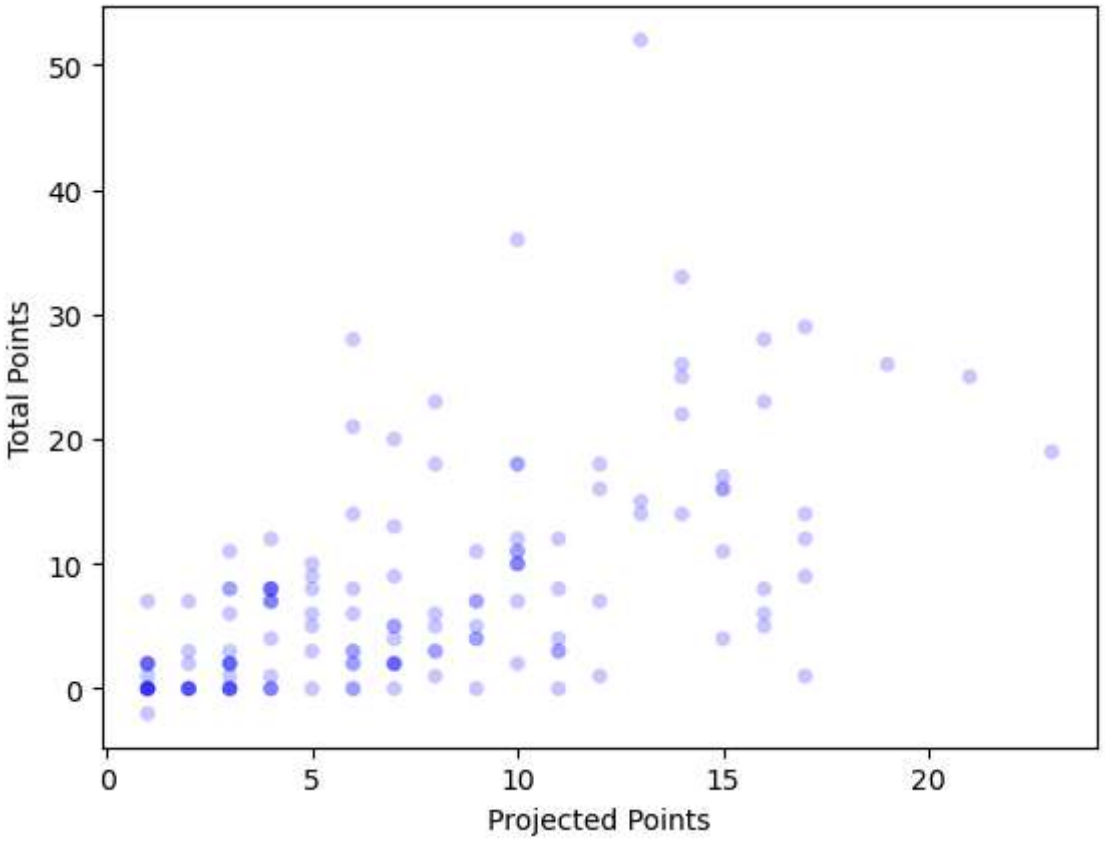
In [362…
```
MakeNormalPlot(not_wr_roundover)
thinkplot.Config(
    title="Projected vs Actual Points Received for Not WRs Probability Plot",
    xlabel="Standard deviations from mean",
    ylabel="ROUNDOVER points",
    loc="upper left")
```



In [110…
```
#scatterplots#########################
```

In [260…
```
proj_points = wr['ROUNDPROJ']
total_points = wr['ROUNDTOTAL']
point_diff = wr['ROUNDOVER']
total_yards = wr['TOTALYARDS']
```

In [262…
```
thinkplot.Scatter(proj_points, total_points)
thinkplot.Show(xlabel='Projected Points',
               ylabel='Total Points')
```



<Figure size 800x600 with 0 Axes>

In [264…
```
#function to determine covariance
def Cov(xs, ys, meanx=None, meany=None):
    xs = np.asarray(xs)
    ys = np.asarray(ys)

    if meanx is None:
        meanx = np.mean(xs)

    if meany is None:
        meany = np.mean(ys)

    cov = np.dot(xs-meanx, ys-meany) / len(xs)
    return cov
```

In [266…
```
Cov(proj_points, total_points)
```

Out[266… 26.019387755102038

In [268…
```
#function to determine Pearson's correlation
def Corr(xs, ys):
    xs = np.asarray(xs)
    ys = np.asarray(ys)

    meanx, varx = thinkstats2.MeanVar(xs)
    meany, vary = thinkstats2.MeanVar(ys)

    corr = Cov(xs, ys, meanx, meany) / math.sqrt(varx * vary)
    return corr
```

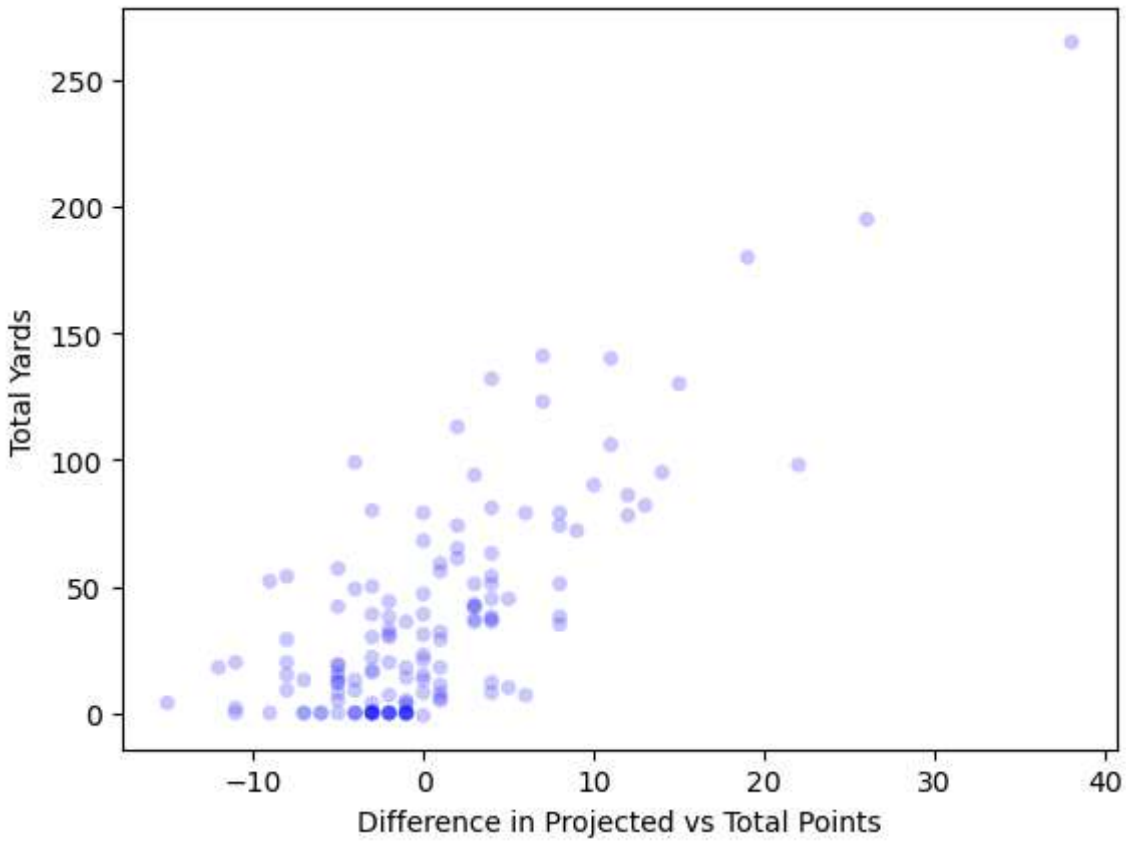
In [270…
```
Corr(proj_points, total_points)
```

Out[270… 0.5836046552567039

In [272…
```
#the number above shows that the relationship between projected and total points is potentially
#and the two values hace a fairly positive linear relationship
```

In [274…
```
#########scatterplot number 2######
```

In [276…
```
thinkplot.Scatter(point_diff, total_yards)
thinkplot.Show(xlabel='Difference in Projected vs Total Points',
               ylabel='Total Yards')
```




```
<Figure size 800x600 with 0 Axes>
```

In [278…
```
Cov(point_diff, total_yards)
```

Out[278…
```
236.71556122448976
```

In [280…
```
Corr(point_diff, total_yards)
```

Out[280…
```
0.7660791286170451
```

In [ ]:
```
#################### HYPOTHESIS TESTING ######################
```

In [ ]:
```
#Null Hypothesis: There is no difference between Wide Receivers and other players,
#and both groups have the same distribution for the ROUNDOVER variable
```

In [290…
```
#calculate difference in means
diff = np.mean(wr_roundover) - np.mean(not_wr_roundover)
diff
```

Out[290…
```
0.37723214285714285
```

In [332…
```
#run a permuation test based on ROUNDOVER between WRs and Others
def permutation_test(wr_points, not_wr_points):
    #Combine both into one pool
    combined_points = np.concatenate([wr_points, not_wr_points])
```

```
    #initialize list
    perm_diffs = []

    #run 10000 permutations
    for _ in range(10000):
        np.random.shuffle(combined_points)

        # Split data back into two groups (same size as original groups)
        group1 = combined_points[:len(wr_points)]
        group2 = combined_points[len(wr_points):]

        # Calculate the difference in means for the 2 new groups
        group_diff = np.mean(group1) - np.mean(group2)
        #put values of means together into one list
        perm_diffs.append(group_diff)

    # Calculate the p-value: Proportion of permuted differences >= observed difference
    p_value = np.mean(np.array(perm_diffs) >= diff)

    return p_value

#Run the permutation test and get the p-value
p_value = permutation_test(wr_roundover, not_wr_roundover)
p_value
```

Out[332… 0.2963

In [ ]:
```
#the p value of around 0.3 means that we cannot reject the null hypothesis, and if wide receivers
#it is due to random chance
```

In [ ]:
```
################### REGRESSION ##############################
```

In [340…
```
#linear regression
formula = 'ROUNDOVER ~ TOTALYARDS'
model = smf.ols(formula, data=wr)
results = model.fit()
results.summary()
```

Out[340…

OLS Regression Results

Dep. Variable:	ROUNDOVER	**R-squared:**	0.587
Model:	OLS	**Adj. R-squared:**	0.584
Method:	Least Squares	**F-statistic:**	196.0
Date:	Fri, 28 Feb 2025	**Prob (F-statistic):**	2.85e-28
Time:	12:47:20	**Log-Likelihood:**	-411.24
No. Observations:	140	**AIC:**	826.5
Df Residuals:	138	**BIC:**	832.4
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	-4.2826	0.512	-8.358	0.000	-5.296	-3.269
TOTALYARDS	0.1251	0.009	14.001	0.000	0.107	0.143

Omnibus:	3.003	**Durbin-Watson:**	0.880
Prob(Omnibus):	0.223	**Jarque-Bera (JB):**	2.478
Skew:	-0.280	**Prob(JB):**	0.290
Kurtosis:	3.335	**Cond. No.**	75.6

Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

In [ ]:

```
#with the high f statistic, it shows that this model does a good job
#explaining any variance in the ROUNDOVER variable
#The p value is most likely not exactly 0, but may be small enough to round to 0
#this means that the result is highly significant
```