In [1]:
```
import matplotlib.pyplot as plt
import numpy as np
import scipy.stats
import seaborn as sns
import math
```

Part B

In [2]:
```
n = 100
even_spacing = [i/n for i in range(n)]
dumbbell = [0] * int(n/2) + [1] * int(n/2)
quad = [0] * int(n/3) + [1] * int(n/3) + [0.5] * int(n/3) + [0.5]

list_of_lists1 = [even_spacing, dumbbell, quad]
```

In [26]:
```
a_const = 5
b_const = 8
# eps = np.random.normal(loc=0, scale=0.5, size=1)
```

In [27]:
```
y1_even = []
y2_dumb = []
y3_quad = []
list_of_lists2 = [y1_even, y2_dumb, y3_quad]
for i in range(3):
    for x in list_of_lists1[i]:
        y = a_const * x + np.random.normal(loc=0, scale=0.5, size=1)
        list_of_lists2[i].append(y[0])
```

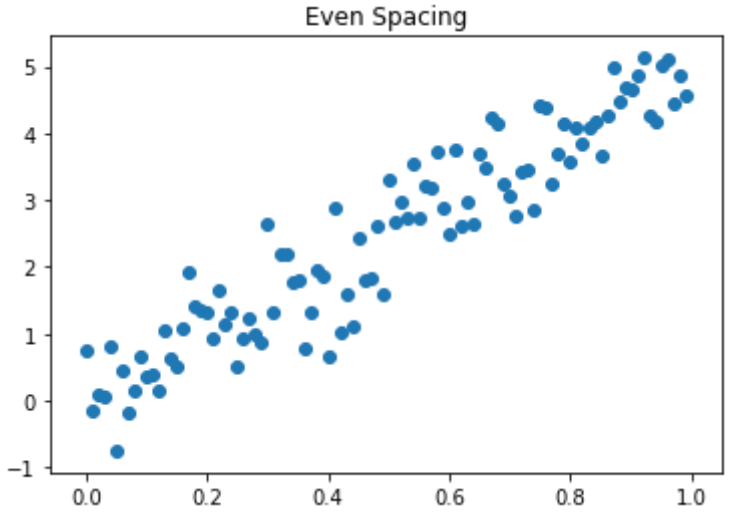
In [28]:
```
a_ols = []

for i in range(3):
    xs = list_of_lists1[i]
    ys = list_of_lists2[i]
    x_bar = np.mean(xs)
    y_bar = np.mean(ys)
    alpha = 0
    for j in range(n):
        alpha += (xs[j] - x_bar) * (ys[j] - y_bar) / (xs[j] - x_bar)**2
#     a = np.sum([x - x_bar for x in xs])*np.sum([y - y_bar for y in ys])/np.sum([(x - x_bar)**2 for x in xs])
    a_ols.append(alpha)
```

```
/usr/local/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:10: RuntimeWarning: invalid value encountered in double_scalars
  # Remove the CWD from sys.path while we load stuff.
```

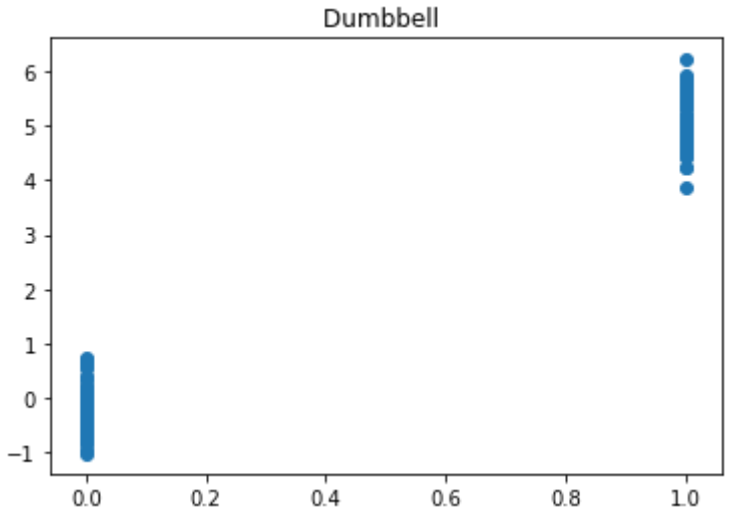
In [29]:
```
a_ols
```

Out[29]:
```
[955.5048739574764, 524.3193985660329, nan]
```

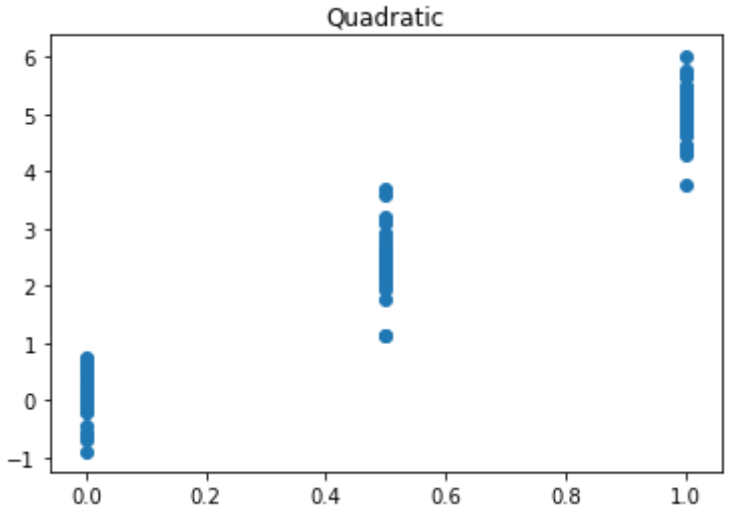
In [34]:
```
plt.scatter(even_spacing, y1_even)
# plt.plot(even_spacing, y1_even)
plt.title('Even Spacing')
plt.show()
```



In [31]:
```
plt.scatter(dumbbell, y2_dumb)
# plt.plot(even_spacing, y1_even)
plt.title('Dumbbell ')
plt.show()
```



In [32]:
```
plt.scatter(quad, y3_quad)
plt.title('Quadratic')
plt.show()
```



In [35]:
```
y1_even = []
y2_dumb = []
y3_quad = []
list_of_lists2 = [y1_even, y2_dumb, y3_quad]
for i in range(3):
    for x in list_of_lists1[i]:
        y = b_const * (x - 0.5)**2 + np.random.normal(loc=0, scale=0.5,
size=1)
        list_of_lists2[i].append(y[0])
```

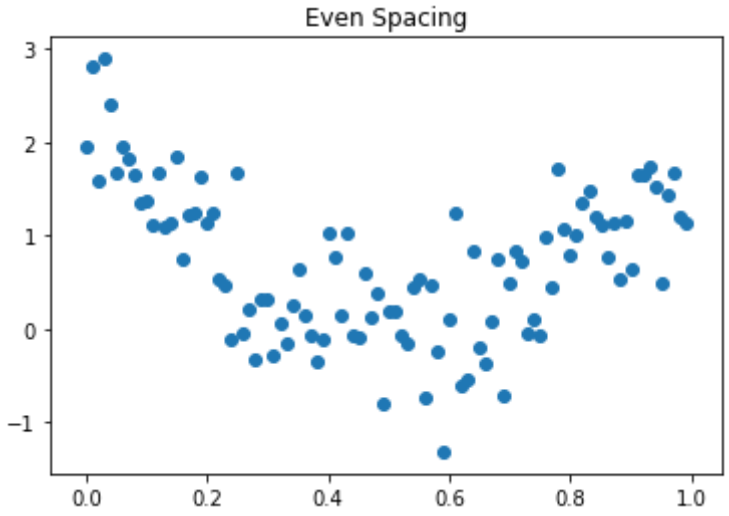
In [36]:
```
a_ols = []

for i in range(3):
    xs = list_of_lists1[i]
    ys = list_of_lists2[i]
    x_bar = np.mean(xs)
    y_bar = np.mean(ys)
    alpha = 0
    for j in range(n):
        alpha += (xs[j] - x_bar) * (ys[j] - y_bar) / (xs[j] - x_bar)**2
    a_ols.append(alpha)
```

```
/usr/local/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:
10: RuntimeWarning: invalid value encountered in double_scalars
  # Remove the CWD from sys.path while we load stuff.
```

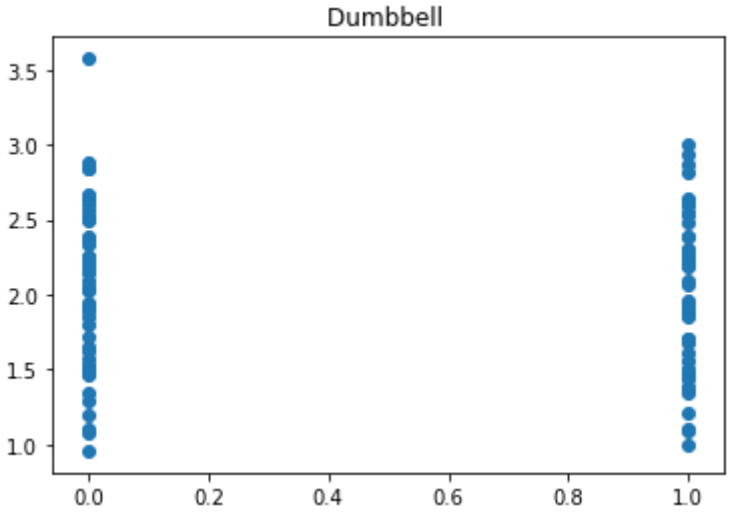
In [37]:
```
a_ols
```

Out[37]:
```
[105.8799360342669, -2.7380566902176735, nan]
```

In [38]:
```
plt.scatter(even_spacing, y1_even)
# plt.plot(even_spacing, y1_even)
plt.title('Even Spacing')
plt.show()
```



In [39]:
```
plt.scatter(dumbbell, y2_dumb)
# plt.plot(even_spacing, y1_even)
plt.title('Dumbbell ')
plt.show()
```



In [40]:
```
plt.scatter(quad, y3_quad)
plt.title('Quadratic')
plt.show()
```