# worksheet.sagews

July 11, 2014

## Contents

```
def dist(v, b, left=float(0), right=float(pi)):
    """
    We divide the interval between left (default: 0) and
    right (default: pi) up into b bins.

    For each number in v (which must left and right),
    we find which bin it lies in and add this to a counter.
    This function then returns the bins and the number of
    elements of v that lie in each one.

    ALGORITHM: To find the index of the bin that a given
    number x lies in, we multiply x by b/length and take the
    floor.
    """
    length = right - left
    normalize = float(b/length)
    vals = {}
    d = dict([(i,0) for i in range(b)])
    for x in v:
        n = int(normalize*(float(x)-left))
        d[n] += 1
    return d, len(v)
```

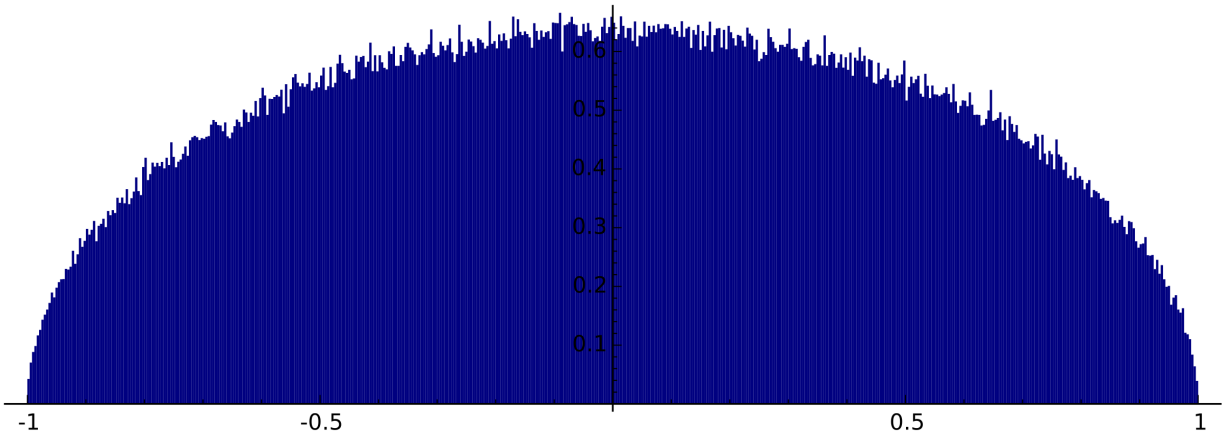
```
def graph(d, b, num=5000, left=float(0), right=float(pi)):
    s = Graphics()
    left = float(left); right = float(right)
    length = right - left
    w = length/b
    k = 0
    for i, n in d.iteritems():
        k += n
        # ith bin has n objects in it.
        s += polygon([(w*i+left,0), (w*(i+1)+left,0),
                      (w*(i+1)+left, n/(num*w)), (w*i+left, n/(num*w))],
                      rgbcolor=(0,0,0.5))
    return s
```

```
%time
```

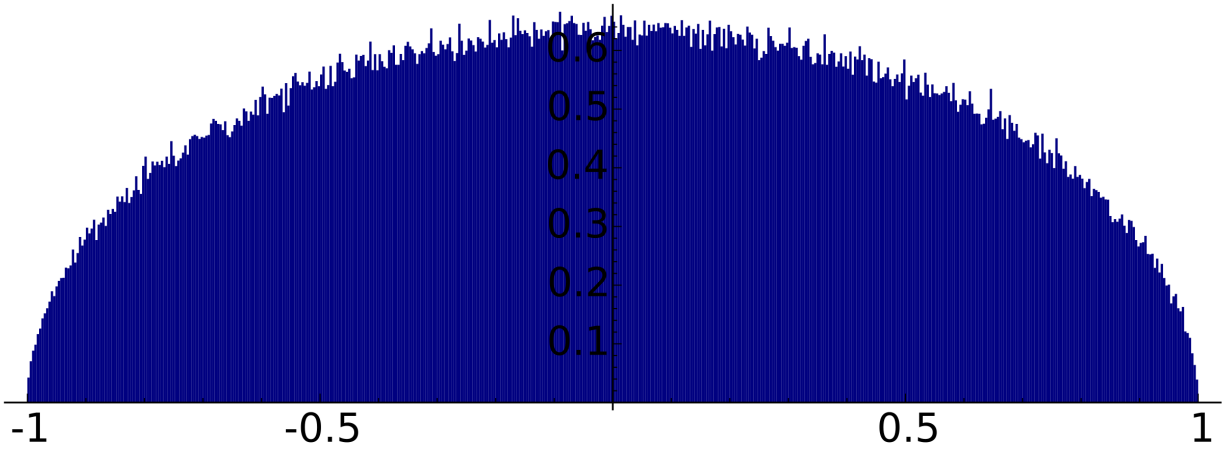
```
n=10^7
D = delta_qexp(n)
v = [D[p]/(2*float(p)^(5.5)) for p in prime_range(n)]
print "normalized"
```

```
%time
b = 500
d, total_number_of_points = dist(v,b,-1,1)
print "distributed"
g = graph(d, b, total_number_of_points, -1, 1)
print "saving..."
g.show()
print ""
```

```
distributed
saving...
```




```
g.show(fontsize=18)
```




```
# First we compute the normalization so
# that the resulting function has integral 1.
```

```
f = maxima('-sin(acos(x))^2/sqrt(1-x^2)')
PI = float(pi)

# It turns out to be 4/3
def f(x):
    if abs(x) == 1 or x < -1:
        return 0
    return (2/PI) * sqrt(1-x^2)
    #return (2/PI)*math.sin(math.acos(x))^2/(sqrt(1-x^2))

def sin2acos():
    PI = float(pi)
    return plot(f, -1.01,1, plot_points=200,
                rgbcolor=(1,0,0), thickness=3, alpha=0.6)
```

```
(g+plot(sin2acos())).save('harris-sato-tate-circle-ten_million.pdf',ymin\
   =0,ymax=.7,figsize=[10,5], fontsize=22)
```