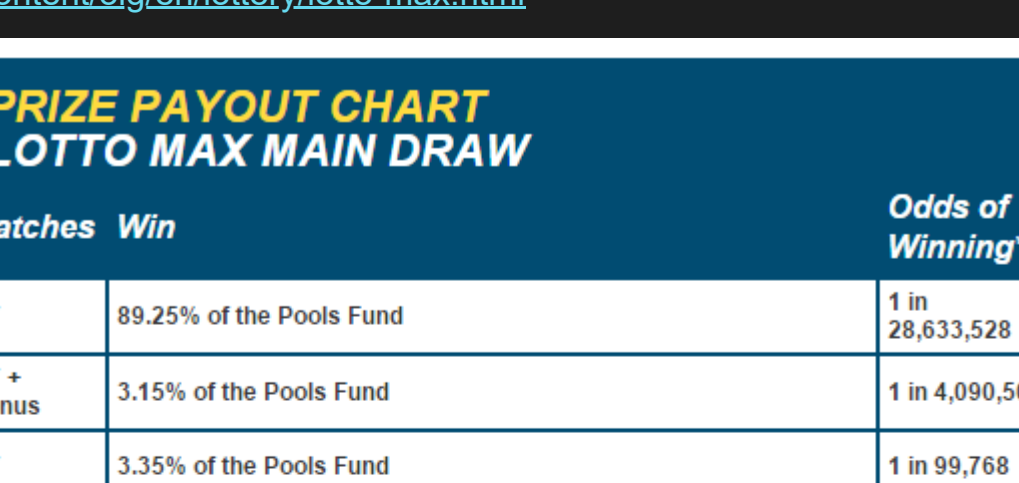
```python
import numpy as np
import pandas as pd
import math, random
from scipy.special import comb
import scipy.stats

import matplotlib
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
sns.set(style="darkgrid")
def UseAwesomeStyle(style, update_rcParams=True): #https://matplotlib.org/users/customizing.html
    style=style.lower()
    if style == "darkgreen":
        params = {"ytick.color" : "w",
                  "xtick.color" : "w",
                  "axes.labelcolor" : "w",
                  "axes.edgecolor" : "w",
                  "text.color" : "w",
                  "grid.color" : (0.5,0,0,0.2),
                  "figure.facecolor" : (0.1,0.2,0.2),
                  "axes.facecolor" : (0.9,0.9,0.9,0.1),
                  "savefig.facecolor" : (0.1,0.2,0.2),
                  "axes.titlepad" : 15,
                  "legend.frameon": True,
                  "legend.facecolor": (0,0,0,0.4),
                  "legend.framealpha": 0.4,
                  "legend.fontsize": 15,
                  "axes.titlesize": 24,
                  "axes.labelsize": 18,
                  "xtick.labelsize" : 14,
                  "ytick.labelsize" : 14,
                 }
    elif style == "dark":
        params = UseAwesomeStyle("darkgreen")
        params["figure.facecolor"] = "#1E1E1E"
        params["savefig.facecolor"] = "#1E1E1E"
    if update_rcParams == True:
        plt.rcParams.update(params)
    return params
UseAwesomeStyle("DarkGreen")

def grouped_barplot(df, cat, subcat, val, err=None, err_colour=(0,0,0,0.5), save=None, dpi=300, debug=False):
    error_bar = False
    error_bar_name = err
    if type(err) == str:
        error_bar = True
    u = df[cat].unique()
    x = np.arange(len(u))
    subx = df[subcat].unique()
    offsets = (np.arange(len(subx))-np.arange(len(subx)).mean())/(len(subx)+1.)
    width= np.diff(offsets).mean()
    for i, gr in enumerate(subx):
        dfg = df[df[subcat]==gr]
        if debug==True:
            print("Group", dfg)
        if error_bar == True:
            err = dfg[error_bar_name].values
            if debug == True:
                print(err)
        ax = plt.bar(x+offsets[i], dfg[val].values, width=width,
                label="{} {}".format(subcat, gr), yerr=err, ecolor=err_colour)
    plt.xlabel(cat)
    plt.ylabel(val)
    plt.xticks(x, u)
    plt.legend()
    plt.tight_layout()
    try:
        plt.gcf().savefig(save, dpi=dpi)
    except: pass
    #plt.show()
    return ax
```

Bonus(3 points). Take frequency distribution of your choice. For example, distribution of mean difference generated in mosquito assignment can be used. Try to find probability distribution function that best describe the distribution. Present probability distribution function (pdf) and cumulative distribution function (cdf) graphically. (Note: you can try probability distribution functions from 'scipy.stats' Python library).

Behold!!!!
Lotto MAX (IQ Tax) Simulator Pro™



Objective: to find the statistical distribution of tickets needed to win a lottery (the grand prize)

Official information:

https://www.playolg.ca/content/olg/en/lottery/lotto-max.html

PRIZE PAYOUT CHART
LOTTO MAX MAIN DRAW

Matches	Win	Odds of Winning*
7/7	89.25% of the Pools Fund	1 in 28,633,528
6/7 + Bonus	3.15% of the Pools Fund	1 in 4,090,504
6/7	3.35% of the Pools Fund	1 in 99,768
5/7	4.25% of the Pools Fund	1 in 1,584
4/7	$20	1 in 71.3
3/7 + Bonus	$20	1 in 76.7
3/7	Free Play ($5 value – three sets of seven computer-generated numbers valid for the next scheduled draw)	1 in 8.1
	Any prize	1 in 6.6

MAXMILLIONS DRAW

Matches	Win	Odds of Winning*
7/7	$1,000,000	1 in 28,633,528

* Per $5 play (approximate).

Expectance:

MATCHES	TICKETS WON	PRIZE
7/7	0	$60,000,000.00
6/7 + Bonus	10	$96,533.10
6/7	175	$5,866.40
5/7	12,875	$101.20
4/7	283,262	$20.00
3/7 + Bonus	265,833	$20.00

Rules: https://www.playolg.ca/content/dam/olg/documents/2017/11/MAX_GameConditions_EN.pdf

4. MAIN DRAW

On each draw date, or as soon as possible thereafter, ILC will cause seven main numbers and one bonus number (being eight different numbers) to be drawn at random from among all numbers from 1 to 49 (the "Main Draw").

5. WINNING SELECTIONS

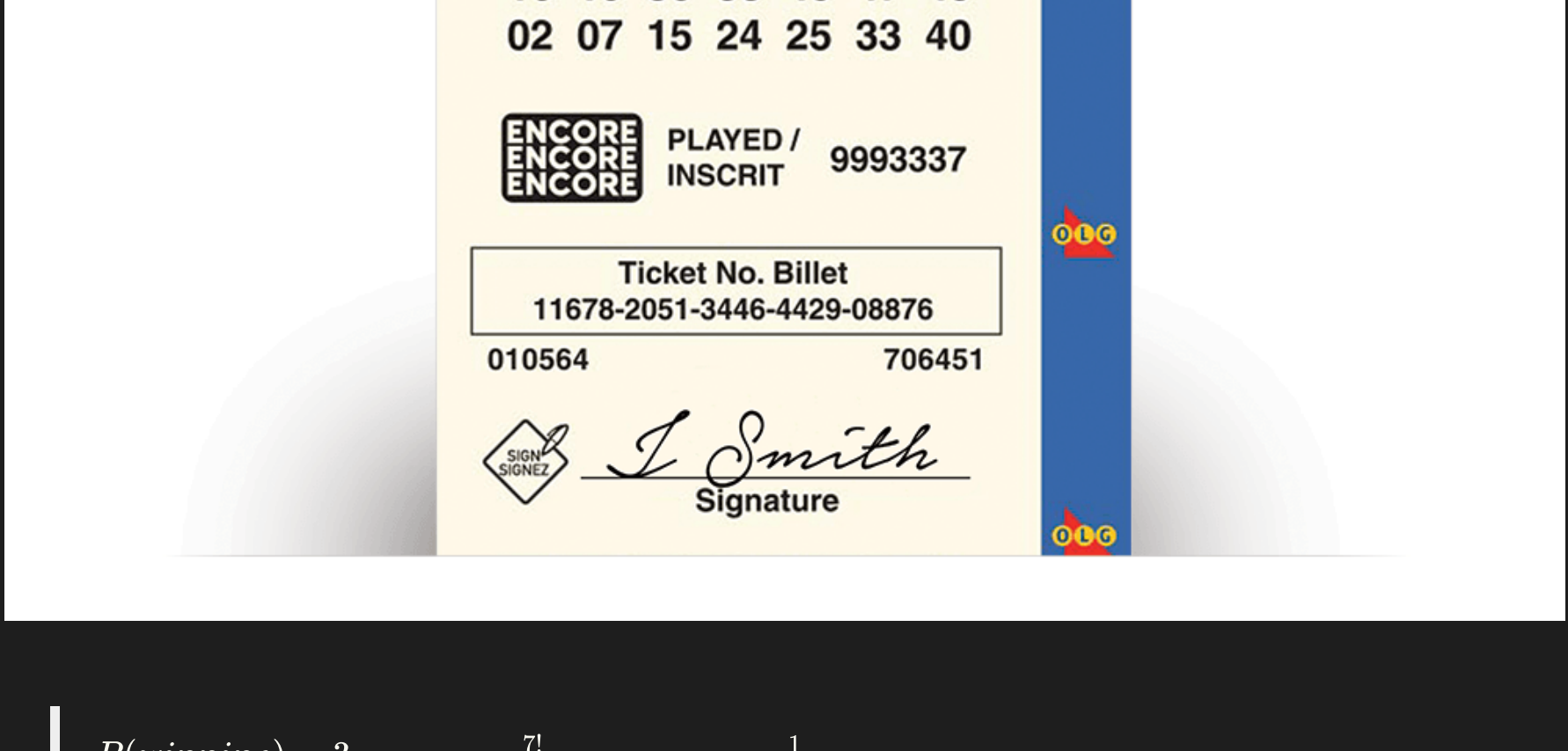
Winning selections as a result of any Main Draw are determined as follows:

WINNING SELECTION	CONSISTS OF
7/7	the seven main numbers
6/7+	any six main numbers and the bonus number
6/7	any six main numbers and one other number*
5/7	any five main numbers and two other numbers* OR
	any five main numbers, one other number* and the bonus number
4/7	any four main numbers and three other numbers* OR
	any four main numbers, two other numbers* and the bonus number
3/7+	any three main numbers, the bonus number and three other numbers*
3/7	any three main numbers and four other numbers*

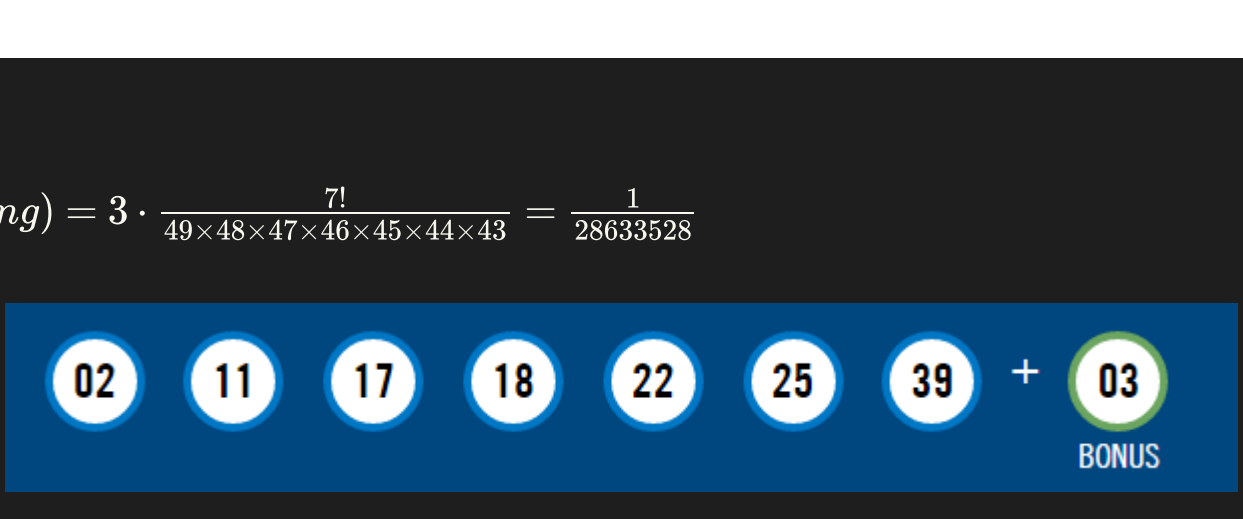
* "other number" means any number which has not been drawn.

How to win the grand prize:

1. Buy a $5 ticket and choose three sequences, each with 7 numbers ranging from 1 to 49 (without resampling)
2. If any of the three sequences match the supposedly randomly generated 7-number target, you win (order doesn't matter because all sequences are sorted in an ascending fashion)



$$P(winning) = 3 \cdot \frac{7!}{49 \times 48 \times 47 \times 46 \times 45 \times 44 \times 43} = \frac{1}{28633528}$$




```python
eon = comb(49,7)/3
p=1/eon
print("P(winning) = 3*1/C(49,7) = 1/%.0f"%eon)
```

```
P(winning) = 3*1/C(49,7) = 1/28633528
```

Hypothesis: The number of tickets bought in a row to win follows Geometric Distribution

Geometric Distribution

If the probability of a success in one trial is p and the probability of a failure is $1-p$, then the probability of finding the first success in the n^{th} trial is given by

$$(1-p)^{n-1}p \qquad (3.30)$$

The mean (i.e. expected value), variance, and standard deviation of this wait time are given by

$$\mu = \frac{1}{p} \qquad \sigma^2 = \frac{1-p}{p^2} \qquad \sigma = \sqrt{\frac{1-p}{p^2}} \qquad (3.31)$$

```python
print("Geometric disctribution (in theory): μ = 1/P =",eon)
print("Geometric disctribution (in theory): σ = √((1-p)/p²) =",((1-p)/p**2)**0.5)
```

```
Geometric disctribution (in theory): μ = 1/P = 28633528.0
Geometric disctribution (in theory): σ = √((1-p)/p²) = 28633527.499999996
```

Simulation 1: just buy tickets with 3 random sequences every time, and hope one of them will match the random target.

Preliminary tests:

I foresee some significant technical challenges (mainly about computing efficiency), so I need to make sure this is doable first.

http://zwmiller.com/blogs/python_data_structure_speed.html
https://wiki.python.org/moin/PythonSpeed/PerformanceTips

```python
l = np.arange(1,50)
a=[23,45,17,12,56,38,12]
b,c,d=[12,56,38,23,45,17,12],[23,45,12,56,38,12,17],[23,45,17,12,56,38,12]
```

```python
%%timeit
a.sort()
a
```

```
217 ns ± 1.29 ns per loop (mean ± std. dev. of 7 runs, 1000000 loops each)
```

```python
%%timeit
a in [b,c,d]
```

```
187 ns ± 1.24 ns per loop (mean ± std. dev. of 7 runs, 10000000 loops each)
```

```python
%%timeit
a in (b, c, d)
```

```
163 ns ± 1.76 ns per loop (mean ± std. dev. of 7 runs, 10000000 loops each)
```

```python
%%timeit
a == b or a==c or a==d
```

```
156 ns ± 0.367 ns per loop (mean ± std. dev. of 7 runs, 10000000 loops each)
```

```python
%%timeit
x1 = np.random.choice(l, 7, replace=False)
x2 = np.random.choice(l, 7, replace=False)
x3 = np.random.choice(l, 7, replace=False)
y = np.random.choice(l, 7, replace=False)
```

```
79.5 µs ± 607 ns per loop (mean ± std. dev. of 7 runs, 10000 loops each)
```

```python
%%timeit
random.randint(1,49)
```

```
1.23 µs ± 4.93 ns per loop (mean ± std. dev. of 7 runs, 1000000 loops each)
```

```python
%%timeit
x1=random.sample(range(1, 50), 7)
x2=random.sample(range(1, 50), 7)
x3=random.sample(range(1, 50), 7)
y=random.sample(range(1, 50), 7)
```

```
35.8 µs ± 121 ns per loop (mean ± std. dev. of 7 runs, 10000 loops each)
```

```python
%%timeit
x1=random.sample(range(1, 50), 7)
x2=random.sample(range(1, 50), 7)
x3=random.sample(range(1, 50), 7)
y=random.sample(range(1, 50), 7)
if y == x1 or y == x2 or y == x3:
    print("aha")
```

```
36.1 µs ± 567 ns per loop (mean ± std. dev. of 7 runs, 10000 loops each)
```

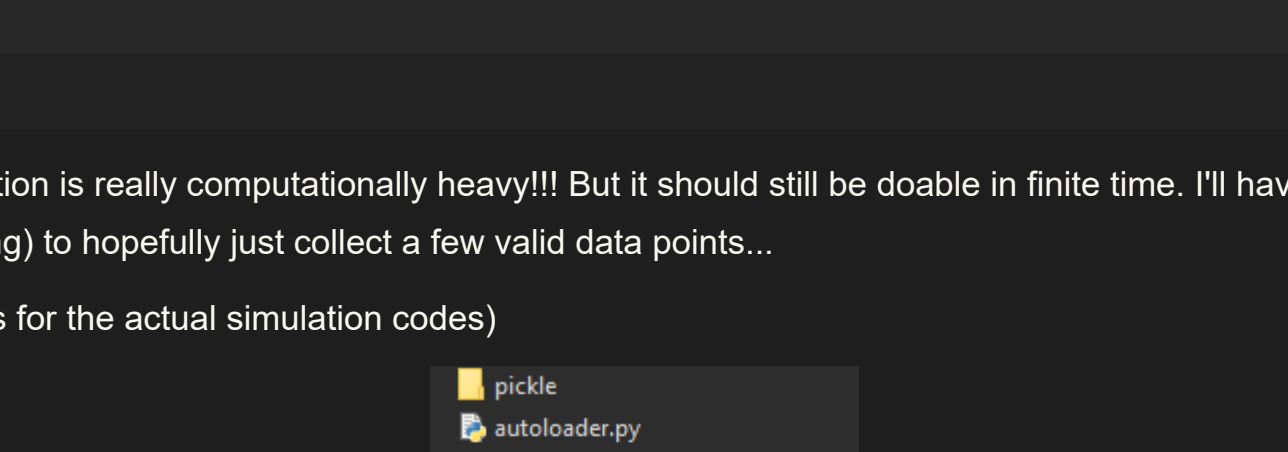
```python
36.1E-6*eon
```

```
1033.6703608
```

Yep! This simulation is really computationally heavy!!! But it should still be doable in finite time. I'll have to use some hack (multi-boxing) to hopefully just collect a few valid data points...

(See the py files for the actual simulation codes)

Even with ~23000 tickets simulated per second, the chance of winning the lottery seems ridiculously slim! This is where one can truly feel the immensity of 28,633,528 (and the black hole of IQ tax)!



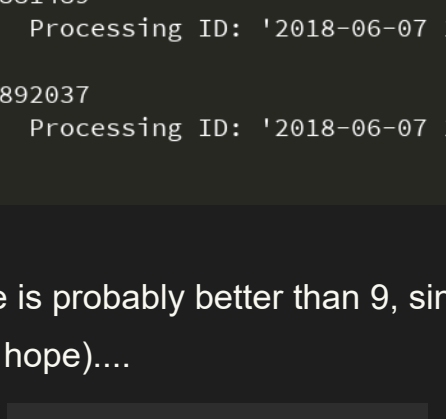
But just like in real life, there're some incredibly lucky guys!

```
✓ Simulation started!!!!
★  Congratulations! You win the Lotto MAX!!! Winning numbers: [5, 12, 13, 18, 20, 35, 43]
▶▶▶ Auto-saving...  Time elapsed: 0:00:01.481058
Current performance: 22152.7 tickets/sec    Processing ID: '2018-06-07 06:06:52.614967' Tickets bought: 16695144
Current winning count: 1 / 1000
▶▶▶ Auto-saving...  Time elapsed: 0:00:10.003066
Current performance: 22997.6 tickets/sec    Processing ID: '2018-06-07 06:27:56.556185' Tickets bought: 195963
Current winning count: 1 / 1000
```

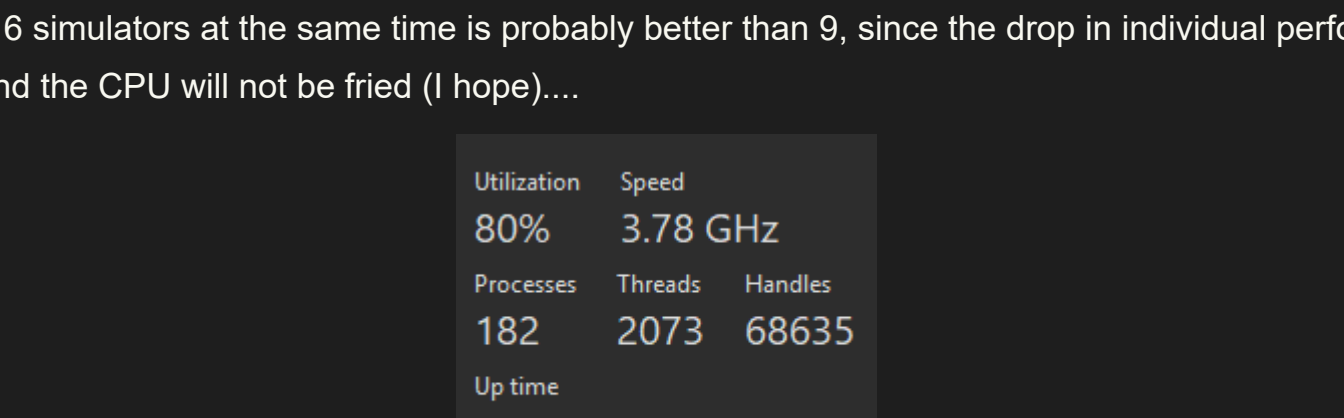
Parallel computing can greatly improve the overall data collection speed, although every single process will have dropped performance.

```
▶▶▶ Auto-saving...  Time elapsed: 9:30:15.874850
Current performance: 14870.7 tickets/sec    Processing ID: '2018-06-07 15:33:04.199475' Tickets bought: 32099373
Current winning count: 20 / 1000
▶▶▶ Auto-saving...  Time elapsed: 9:30:25.881489
Current performance: 13805.5 tickets/sec    Processing ID: '2018-06-07 15:33:04.199475' Tickets bought: 32237520
Current winning count: 20 / 1000
▶▶▶ Auto-saving...  Time elapsed: 9:30:35.892037
Current performance: 14495.3 tickets/sec    Processing ID: '2018-06-07 15:33:04.199475' Tickets bought: 32382626
Current winning count: 20 / 1000
```

I found running 6 simulators at the same time is probably better than 9, since the drop in individual performance is not too much and the CPU will not be fried (I hope)....



After a day of running, the parallel computing is done (and my PC isn't smoking)!



Now I can put all my simulation results together.

```python
import os
pickle_folder = os.getcwd()+"\\Project Lotto MAX\\pickle\\df\\"
pickle_names = []
for root, dirs, files in os.walk(pickle_folder):
    pickle_names = [name for name in files if "LottoMAX_df" in name] #filter out the wanted files
df_list = [pd.read_pickle(pickle_folder+name) for name in pickle_names]
df = pd.concat(df_list)
df = df[df["won"]>0] #keep only the finished simulations (not winning = unfinished)
df
```

gambler ID	won	numbers	tickets_count
2018-06-07 06:06:31.479087	1	[1, 4, 14, 28, 30, 32, 47]	7018908
2018-06-07 06:06:52.614967	1	[5, 12, 13, 18, 20, 35, 43]	16695144
2018-06-07 06:27:56.556185	1	[9, 10, 15, 25, 29, 38, 42]	33793844
2018-06-07 07:02:46.455574	1	[7, 10, 30, 32, 36, 44, 47]	8150757
2018-06-07 07:11:58.713924	1	[2, 7, 14, 15, 20, 46, 49]	22320876
2018-06-07 07:37:06.934246	1	[1, 15, 17, 20, 23, 28, 31]	32957297
2018-06-07 08:14:13.851543	1	[4, 12, 24, 32, 40, 43, 49]	51386160
2018-06-07 09:12:04.741708	1	[2, 19, 23, 26, 37, 38, 39]	41508879
2018-06-07 09:58:59.436253	1	[11, 18, 23, 29, 33, 38, 46]	46837131
2018-06-07 10:51:32.469849	1	[9, 15, 17, 22, 27, 35, 47]	19549300
2018-06-07 11:13:26.791337	1	[9, 11, 18, 34, 39, 40, 44]	12960970
2018-06-07 11:28:00.387604	1	[9, 13, 22, 33, 38, 47, 49]	40790608
2018-06-07 12:13:46.403723	1	[2, 10, 26, 29, 30, 44, 48]	8602555
2018-06-07 12:23:26.898487	1	[5, 8, 12, 20, 36, 42, 44]	16430174
2018-06-07 12:41:55.046302	1	[5, 10, 20, 21, 26, 44, 45]	18095214
2018-06-07 13:02:13.272997	1	[13, 16, 30, 32, 34, 36, 40]	48424147
2018-06-07 13:56:33.902576	1	[3, 12, 25, 26, 28, 40, 46]	7598187
2018-06-07 14:05:06.986660	1	[2, 6, 12, 27, 34, 37, 49]	80256903
2018-06-07 15:34:59.318385	1	[6, 12, 19, 21, 31, 33, 42]	8229213
2018-06-07 15:44:10.301787	1	[1, 25, 36, 42, 43, 46, 48]	45948635
2018-06-07 16:36:34.948683	1	[5, 18, 21, 26, 28, 40, 42]	8428
2018-06-07 16:36:35.495594	1	[3, 20, 22, 24, 31, 35, 42]	52080471
2018-06-07 17:33:44.470107	1	[4, 10, 14, 28, 36, 43, 47]	44852310
2018-06-07 18:22:56.974049	1	[1, 5, 8, 13, 17, 35, 47]	27033513
2018-06-07 18:52:36.595950	1	[9, 14, 19, 27, 29, 30, 37]	61176962
2018-06-07 06:30:03.749856	1	[12, 18, 30, 35, 37, 43, 45]	5281420
2018-06-07 06:34:42.921263	1	[10, 12, 13, 16, 19, 26, 49]	89134320
2018-06-07 08:13:22.943494	1	[1, 6, 15, 28, 33, 40, 43]	5173705
2018-06-07 08:19:07.774541	1	[4, 13, 14, 24, 26, 33, 37]	37556268
2018-06-07 09:01:04.907622	1	[10, 14, 25, 35, 40, 41, 47]	79005530
...	...	...	...
2018-06-07 10:11:36.140920	1	[9, 15, 27, 29, 35, 42, 46]	13075662
2018-06-07 10:26:08.156787	1	[25, 26, 30, 33, 43, 46, 49]	33911780
2018-06-07 11:03:37.151372	1	[11, 14, 24, 26, 32, 43, 47]	20050349
2018-06-07 11:25:48.660563	1	[11, 14, 18, 21, 27, 30, 42]	19899210
2018-06-07 11:47:50.583504	1	[13, 14, 16, 20, 37, 44, 45]	11073210
2018-06-07 12:00:05.094893	1	[1, 3, 7, 16, 17, 27, 47]	17840765
2018-06-07 12:19:45.118060	1	[8, 10, 14, 17, 19, 29, 40]	409594
2018-06-07 12:20:12.448778	1	[7, 10, 26, 30, 34, 41, 42]	2330435
2018-06-07 12:22:46.143451	1	[1, 2, 19, 21, 26, 31, 32]	13051352
2018-06-07 12:37:10.676800	1	[4, 10, 12, 16, 18, 42, 48]	11644488
2018-06-07 12:50:02.093708	1	[10, 18, 21, 23, 27, 38, 41]	45639439
2018-06-07 13:40:30.313198	1	[1, 8, 11, 20, 31, 39, 45]	13707133
2018-06-07 13:55:40.337695	1	[10, 13, 21, 29, 31, 39, 41]	45706426
2018-06-07 14:46:12.882442	1	[6, 14, 16, 29, 30, 37, 42]	42107669
2018-06-07 15:33:04.199475	1	[8, 23, 24, 25, 28, 35, 36]	55275601
2018-06-07 16:35:20.092468	1	[1, 5, 10, 25, 26, 27, 48]	139011
2018-06-07 16:35:29.517294	1	[11, 15, 16, 27, 42, 46, 49]	6575245
2018-06-07 16:42:38.975193	1	[6, 17, 18, 34, 39, 43, 49]	6563879
2018-06-07 16:49:42.041934	1	[4, 25, 32, 35, 37, 43, 44]	10614114
2018-06-07 17:01:04.353402	1	[3, 14, 20, 21, 22, 39, 41]	7077150
2018-06-07 17:08:41.805197	1	[6, 18, 22, 23, 34, 36, 48]	17779624
2018-06-07 17:28:02.864802	1	[8, 12, 13, 16, 19, 34, 42]	38377867
2018-06-07 18:09:24.968247	1	[7, 13, 14, 33, 35, 44, 45]	8375979
2018-06-07 18:18:32.782311	1	[4, 7, 16, 20, 32, 37, 48]	34505305
2018-06-07 18:55:53.061285	1	[14, 15, 18, 28, 32, 48, 49]	13683149
2018-06-07 19:10:37.303608	1	[5, 19, 30, 31, 36, 43, 49]	19393583
2018-06-07 19:31:34.469041	1	[5, 8, 9, 20, 39, 44, 49]	741408
2018-06-07 19:32:22.186285	1	[11, 18, 21, 28, 34, 41, 49]	7927453
2018-06-07 19:41:02.632712	1	[1, 9, 13, 16, 18, 29, 38]	34786218
2018-06-07 20:19:17.221445	1	[2, 29, 32, 36, 39, 42, 47]	30069558

167 rows × 3 columns

```python
print("Mean of tickets bought in a row to win the lottery: %.1f"% df["tickets_count"].mean())
print("Std of tickets bought in a row to win the lottery: %.1f"% df["tickets_count"].std())
print("Min of tickets bought in a row to win the lottery:", df["tickets_count"].min())
print("Max of tickets bought in a row to win the lottery:", df["tickets_count"].max())
```

```
Mean of tickets bought in a row to win the lottery: 27528531.2
Std of tickets bought in a row to win the lottery: 23541571.6
Min of tickets bought in a row to win the lottery: 8428
Max of tickets bought in a row to win the lottery: 123475388
```

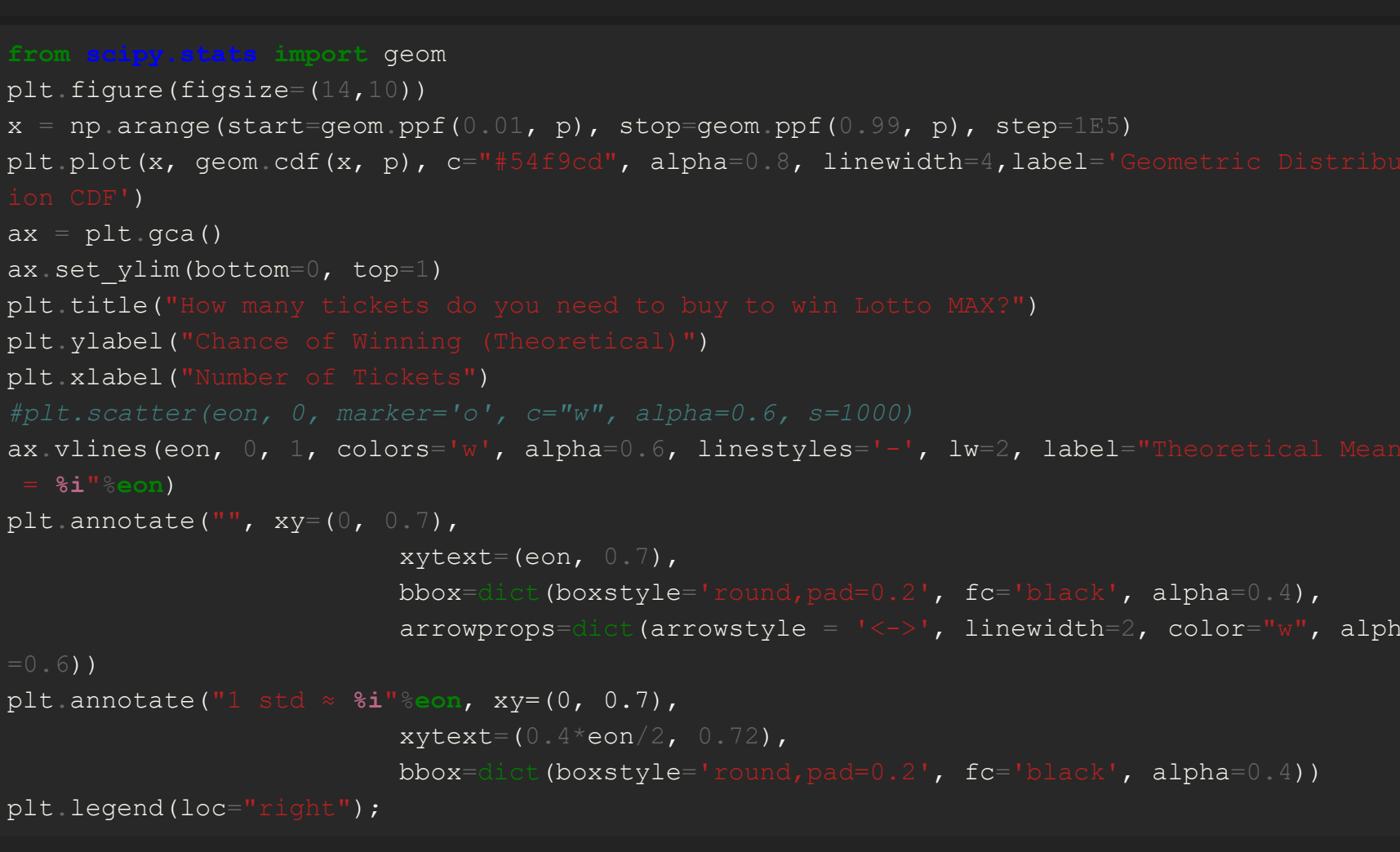
```python
scipy.stats.ttest_1samp(df["tickets_count"], eon) #t-test for the hypothesized mean
```

```
Ttest_1sampResult(statistic=-0.6065739924318633, pvalue=0.544962318894207)
```

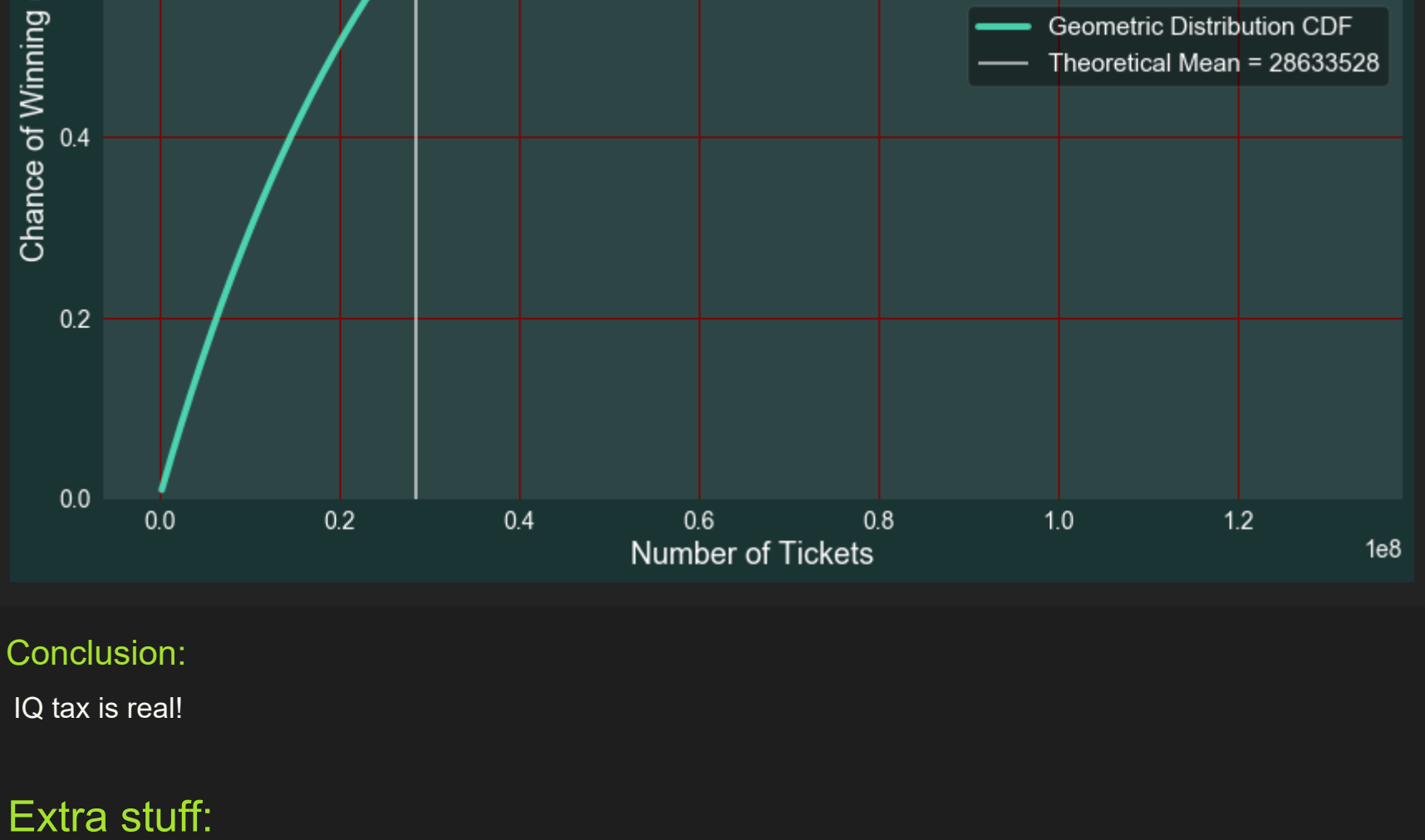
The simulation results agree with the theoretical geometric distribution

—— for the descrete variable: *number of tickets bought in a row to win the grand prize*

```python
fig, ax = plt.subplots(figsize=(14,10))
N, bins, patches = ax.hist(df["tickets_count"].values.tolist(), density=True, bins=math.ceil(len(df)**0.5), alpha=0.9)
my_colors = [(0.85, x/len(bins), 0.35) for x in range(len(bins))]
for i in range(0,len(bins)-1):
    patches[i].set_facecolor(my_colors[i])
plt.title("How many tickets do you need to buy to win Lotto MAX? \n(%.0f simulations; normalized)"%len(df))
plt.ylabel("Probability Density")
plt.xlabel("Number of Tickets")
plt.annotate("Theoretical Mean", xy=(eon, 0),
                     xytext=(0.8*eon, -0.08*ax.get_ylim()[1]),
                     bbox=dict(boxstyle='round,pad=0.2', fc='black', alpha=0.4),
                     arrowprops=dict(arrowstyle = '->',
                                     connectionstyle='arc3,rad=-0.0', linewidth=2, color="w"))
from scipy.stats import geom
x = np.arange(start=geom.ppf(0.01, p), stop=geom.ppf(0.99, p), step=1E5)
ax.plot(x, geom.pmf(x, p), c="gold", alpha=0.8, linewidth=4,label='Geometric Distribution PMF (Theoretical)')
ax.legend(loc="best");
```




```python
from scipy.stats import geom
plt.figure(figsize=(14,10))
x = np.arange(start=geom.ppf(0.01, p), stop=geom.ppf(0.99, p), step=1E5)
plt.plot(x, geom.cdf(x, p), c="#54f9cd", alpha=0.8, linewidth=4,label='Geometric Distribution CDF')
ax = plt.gca()
ax.set_ylim(bottom=0, top=1)
plt.title("How many tickets do you need to buy to win Lotto MAX?")
plt.ylabel("Chance of Winning (Theoretical)")
plt.xlabel("Number of Tickets")
#plt.scatter(eon, 0, marker='o', c="w", alpha=0.6, s=1000)
ax.vlines(eon, 0, 1, colors='w', alpha=0.6, linestyles='-', lw=2, label="Theoretical Mean = %i"%eon)
plt.annotate("", xy=(0, 0.7),
                     xytext=(eon, 0.7),
                     bbox=dict(boxstyle='round,pad=0.2', fc='black', alpha=0.4),
                     arrowprops=dict(arrowstyle = '<->', linewidth=2, color="w", alpha=0.6))
plt.annotate("1 std ≈ %i"%eon, xy=(0, 0.7),
                     xytext=(0.4*eon/2, 0.72),
                     bbox=dict(boxstyle='round,pad=0.2', fc='black', alpha=0.4))
plt.legend(loc="right");
```



Conclusion:

IQ tax is real!

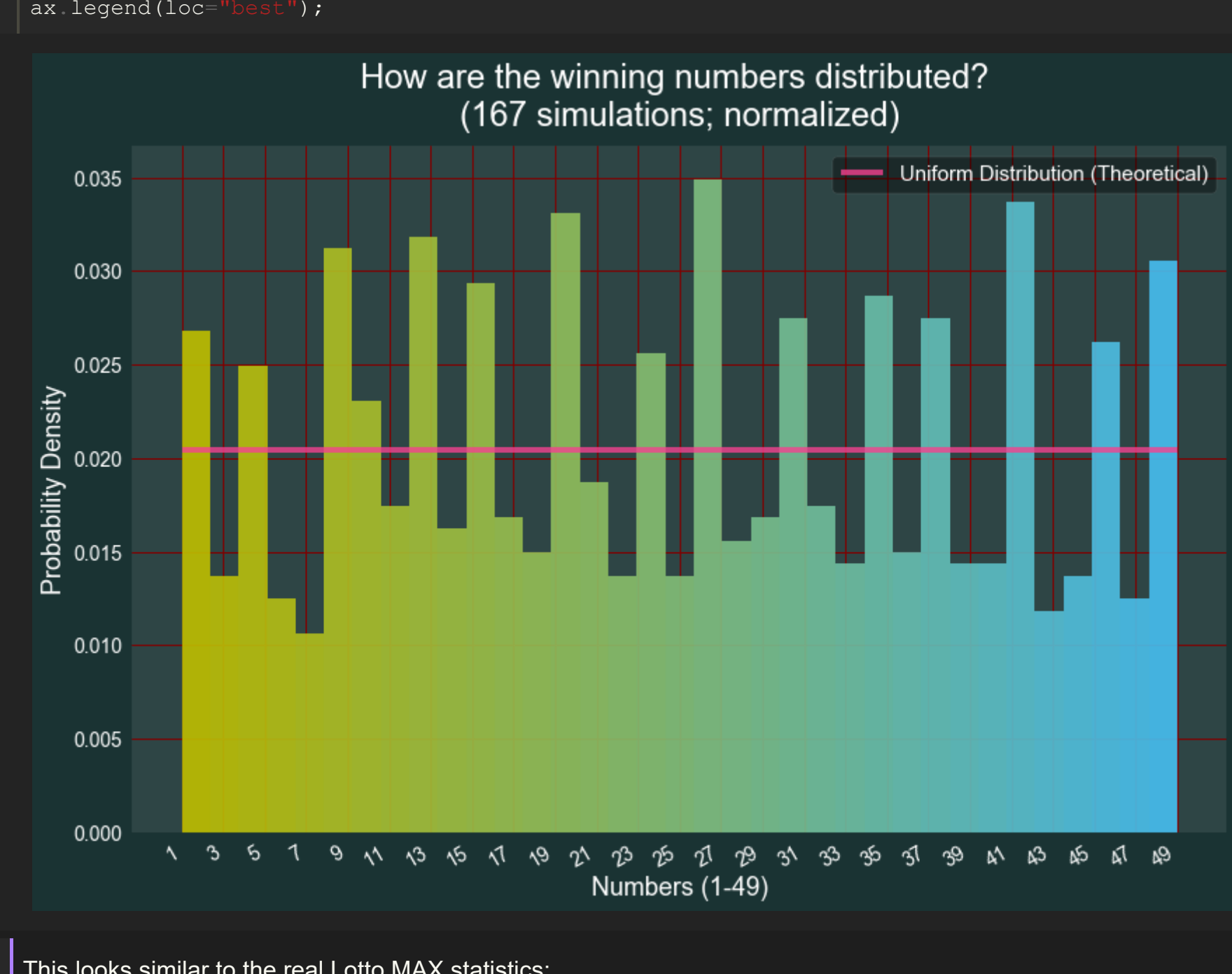
Extra stuff:

What's the winning numbers' distribution? Are they truly random?

```python
all_numbers = [[]+x for x in df["numbers"].values]
all_numbers = [y for x in all_numbers for y in x]
len(all_numbers)/7
```

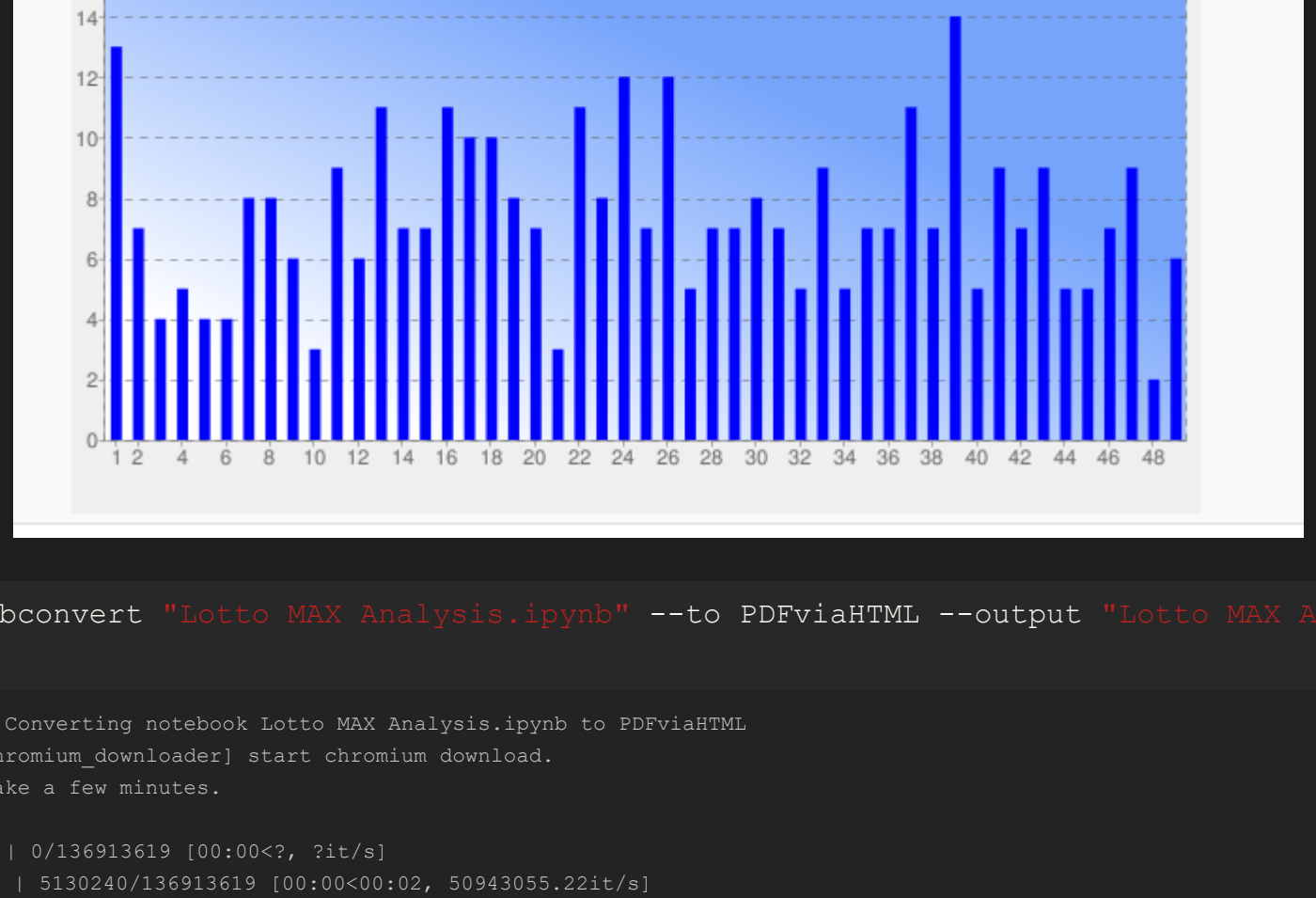
```
167.0
```

In [654]:
```python
fig, ax = plt.subplots(figsize=(14,10))
N, bins, patches = ax.hist(all_numbers, density=True, bins=math.ceil(len(all_numbers)**0.5
), alpha=0.9)
my_colors = [(0.75-x/len(bins)/2, 0.75, x/len(bins)) for x in range(len(bins))]
for i in range(0,len(bins)-1):
    patches[i].set_facecolor(my_colors[i])
plt.title("How are the winning numbers distributed? \n(%.0f simulations; normalized)"%len
(df))
plt.ylabel("Probability Density")
plt.xlabel("Numbers (1-49)")
ax.hlines(1/49, 1, 49, colors='#f4428f', alpha=0.8, linestyles='-', lw=4, label="Uniform D
istribution (Theoretical)")
plt.xticks(np.arange(min(all_numbers), max(all_numbers)+1, 2))
fig.autofmt_xdate()
ax.legend(loc="best");
```



This looks similar to the real Lotto MAX statistics:

http://www.portalseven.com/lottery/canada_lotto_max_number_frequency.jsp



In [12]:
```
!jupyter nbconvert "Lotto MAX Analysis.ipynb" --to PDFviaHTML --output "Lotto MAX Analysi
s.pdf"
```

```
[NbConvertApp] Converting notebook Lotto MAX Analysis.ipynb to PDFviaHTML
[W:pyppeteer.chromium_downloader] start chromium download.
Download may take a few minutes.

  0%|          | 0/136913619 [00:00<?, ?it/s]
  4%|▍         | 5130240/136913619 [00:00<00:02, 50943055.22it/s]
  9%|▉         | 12666880/136913619 [00:00<00:02, 56410698.62it/s]
 14%|█▍        | 19210240/136913619 [00:00<00:02, 58818920.32it/s]
 18%|█▊        | 24340480/136913619 [00:00<00:02, 56200431.07it/s]
 23%|██▎       | 32030720/136913619 [00:00<00:01, 61108714.78it/s]
 28%|██▊       | 38973440/136913619 [00:00<00:01, 61251808.16it/s]
 34%|███▍      | 47124480/136913619 [00:00<00:01, 66110935.04it/s]
 39%|███▉      | 53657600/136913619 [00:00<00:01, 65757898.35it/s]
 44%|████▍     | 60426240/136913619 [00:00<00:01, 66316323.58it/s]
 49%|████▉     | 67471360/136913619 [00:01<00:01, 67090693.00it/s]
 54%|█████▍    | 74577920/136913619 [00:01<00:00, 68061021.36it/s]
 59%|█████▉    | 81346560/136913619 [00:01<00:00, 66006712.26it/s]
 65%|██████▍   | 88688640/136913619 [00:01<00:00, 67759775.01it/s]
 70%|███████   | 95897600/136913619 [00:01<00:00, 68883153.27it/s]
 75%|███████▌  | 102799360/136913619 [00:01<00:00, 68640166.43it/s]
 80%|████████  | 109926400/136913619 [00:01<00:00, 69230984.75it/s]
 85%|████████▌ | 116858880/136913619 [00:01<00:00, 68668041.14it/s]
 91%|█████████ | 124262400/136913619 [00:01<00:00, 70146208.64it/s]
 96%|█████████▌| 131297280/136913619 [00:01<00:00, 69556169.43it/s]
100%|██████████| 136913619/136913619 [00:02<00:00, 67465568.60it/s]
[W:pyppeteer.chromium_downloader]
chromium download done.
[W:pyppeteer.chromium_downloader] chromium extracted to: C:\Users\zx\AppData\Local\pyppeteer\pyppeteer\local-chromium\588429
[NbConvertApp] Writing 2747412 bytes to Lotto MAX Analysis.pdf
```