BAN200 Week 05 Homework

To complete the homework you will need to modify this template by adding Python code and/or text.

Before starting the homework, make sure to save a copy of this template to your personal Google Drive. If you haven't saved your own copy, any changes you make will be lost when you close your browser window.

To submit your homework: go to "File" in the Colab menu bar > select "Download" > select "Download .ipynb". This will download a ".ipynb" file to your computer. You must submit this file.

The homework is to be completed in groups. It is due at the start of next class.

Homework is graded on the following scale:

- 100% -- The assignment was submitted on time, any code runs without errors, and every question is answered correctly.
- 80% -- The assignment was submitted on time, any code runs without errors, and every question is answered. Some questions may be incorrect, but the submission demonstrates an average level of effort and average level of understanding of the material.
- 60% -- The submission demonstrates a below-average level of effort and below-average level of understanding of the material. This is the highest grade that should be given to submissions that are submitted late, have code that throws uncaught errors, or leave some questions unanswered.
- 0% -- No assignment was submitted, or the submission demonstrates little-to-no effort and little-to-no understanding of the material.

Email Subject Lines Data

This homework follows a case that is very similar to the one from class.

An online retailer has been testing a variety of email promotions. Each promotion offers a certain percentage savings and a different subject line. The retailer is interested in understanding how the percentage savings and subject line content are impacting open rate.

The dataset email_subject_lines_data.txt contains one row for each of 80 previous promotions, along with the following variables:

- subject line the email's subject line
- coupon_or_discount 1 if the subject line contains the word 'coupon', 0 if it contains the word 'discount' (for the purposes of this analysis, we are going to assume the main difference between subject lines is whether the word 'coupon' or the word 'discount' was used)
- savings pct the percentage savings offered in the email subject line
- open_rate the open rate of the email

Create a pandas dataframe from email_subject_lines_data.txt . You can find this file on the course website. You should download it from the course website and upload it to this VM using the tab on the left. Once you've created the dataframe, display it so you can take a look at it.

```
In [4]: # put your answer here
import pandas as pd
df = pd.read_csv('email_subject_lines_data.txt', delimiter='\t')
df
```

	subject_line	coupon_or_discount	savings_pct	open_rate
0	Unlock your exclusive coupon: Get 32% off now!	1	32	34
1	Savings Alert: 25% off with your special coupo	1	25	31
2	17% off your next purchase with this coupon code!	1	17	25
3	Save 19% instantly: Your coupon awaits!	1	19	25
4	Exclusive Offer: 14% off with this coupon!	1	14	23
•••				
75	Take 24% Off Your Order with This Coupon!	1	24	23
76	Enjoy 13% Off: Your Special Coupon Inside!	1	13	21
77	Savings Alert: Your 15% Off Coupon Awaits!	1	15	19
78	Special Coupon: Take 28% Off Your Purchase!	1	28	31
79	Act Fast: 15% Off Coupon Inside!	1	15	24

80 rows × 4 columns

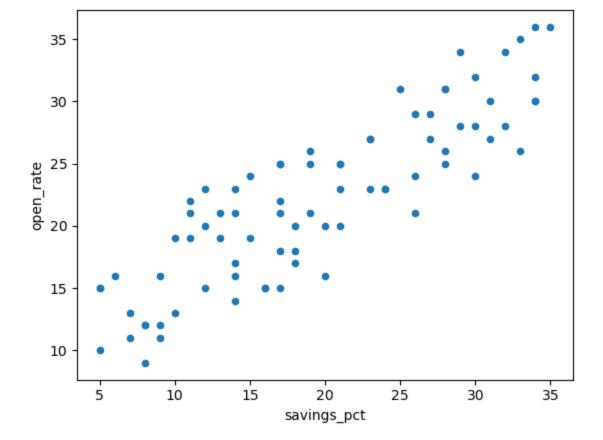
Out[4]:

Question 2

Create a scatterplot of savings_pct vs open_rate. Make sure the variable we are trying to predict is on the vertical axis.

```
In [5]: # put your answer here
    import matplotlib.pyplot as plt
    df.plot(kind='scatter', x='savings_pct', y='open_rate')

Out[5]: <Axes: xlabel='savings_pct', ylabel='open_rate'>
```



Create a numpy array called y that contains open_rate.

Question 4

Create a numpy array called $\ x \$ that contains $\$ savings_pct $\$.

<u>Ouestio</u>n 5

Loading [MathJax]/extensions/Safe.js

Create a keras input object with size 1. Call this object input.

Question 6

Creata a keras layer that takes input and returns a single value. Call this layer linear regression.

Question 7

Create a keras model that takes input as the inputs and linear regression as the outputs.

```
In [14]: # put your answer here
    model = keras.Model(inputs=input, outputs=linear_regression)
    model

Out[14]: 

ckeras.engine.functional.Functional at 0x2861f2410>
```

Question 8

Compile the model using the optimizer and loss function discused in class.

```
In [15]: # put your answer here
model.compile(optimizer='adam', loss='mean_squared_error')
```

Question 9

Train the model on the x and y arrays defined earlier. Train for 500 epochs on a batch size of 1. Make sure to save the model history: we'll use it in the next question.

```
In [16]: # put your answer here
history = model.fit(x,y,batch_size=1,epochs=500)
```

80/80	[=========]	-	0s	347us/step	-	loss:	37.8148
	4/500						
	[======]	-	0s	355us/step	-	loss:	31.2767
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Epoch	172/500						
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	[======================================	_	0.5	330us/sten	_	10881	15 5672
	176/500		03	330 437 3 CCP		1033.	10.0072
	[=========]	_	0s	326us/step	_	loss:	15.5373
Epoch	177/500						
80/80	[======]	-	0s	554us/step	-	loss:	15.4868
	178/500						
	[=======]	-	0s	383us/step	-	loss:	15.5403
	179/500 [=========]		0.0	245 / 0 + 0 0		1	15 4400
	180/500	-	ΘS	315us/step	-	1088:	15.4423
	[==========]	_	00	323us/sten	_	10881	15 4374
	181/500		03	020 037 3 CCP		1033.	10.4074
	[========]	-	0s	344us/step	-	loss:	15.3909
Epoch	182/500						
	[======]	-	0s	342us/step	-	loss:	15.3611
	183/500					_	
	[======================================	-	0s	354us/step	-	loss:	15.3453
	184/500 [========]		00	24110/0+00		10001	15 0044
	185/500	-	08	341uS/Step	-	1088:	15.3344
	[========]	_	0s	332us/step	_	loss:	15.2710
	186/500						
80/80	[=======]	-	0s	330us/step	-	loss:	15.2406
	187/500						
	[=======]	-	0s	330us/step	-	loss:	15.2268
	188/500		•	044 - /-1		1	15 1000
	[=========] 189/500	-	0S	344us/step	-	TOSS:	15.1863
	[======================================	_	00	526us/sten	_	10881	15 1635
	190/500		03	320u3/31cp		1033.	13.1003
	[=========]	_	0s	482us/step	_	loss:	15.1139
Epoch	191/500						
	[======]	-	0s	340us/step	-	loss:	15.0904
	192/500					_	
	[========]	-	0s	410us/step	-	loss:	15.0642
	193/500 [========]		0.0	422ua /ata=		1000:	15 0504
	194/500	-	บร	433uS/Step	-	T088:	15.0594
	[======================================	_	0.5	559us/sten	_	1088:	15.0205
Fnoch	195/500					_500.	
ax]/extensio	ns/Safe.js						

80/80	[========]	-	0s	554us/step	_	loss:	15.0692
	196/500						
80/80	[=======]	-	0s	621us/step	-	loss:	14.9639
	197/500						
	[======]	-	0s	360us/step	-	loss:	14.9424
	198/500						
	[======================================	-	0s	354us/step	-	loss:	14.9219
	199/500 [=========]		0.0	266us/ston		10001	1/ 0500
	200/500	_	03	300us/step	-	1055.	14.0590
	[=========]	_	05	362us/sten	_	loss:	14.9377
	201/500		•	001a3, 000p			
80/80	[=======]	-	0s	364us/step	-	loss:	14.8295
	202/500						
	[======]	-	0s	349us/step	-	loss:	14.8177
	203/500		_	/ /			
	[======================================	-	0s	355us/step	-	Toss:	14.7906
	204/500 [===================================	_	۵e	33711c/cton	_	10001	1/ 7551
	205/500	_	03	337 d 37 3 t e p	_	1033.	14.7331
	[========]	_	0s	370us/step	_	loss:	14.7129
Epoch	206/500			·			
	[=======]	-	0s	362us/step	-	loss:	14.6816
	207/500						
	[========]	-	0s	351us/step	-	loss:	14.6796
	208/500		0.0	400a /atan		1	14 0470
	[=====================================	-	05	402us/step	-	1088:	14.6479
	[======================================	_	05	397us/sten	_	loss:	14.6546
	210/500		00	00 7 407 5 ccp		10001	1410040
	[======]	-	0s	345us/step	-	loss:	14.6680
Epoch	211/500						
	[=======]	-	0s	343us/step	-	loss:	14.6295
	212/500		_				
	[=====================================	-	0S	346us/step	-	TOSS:	14.5458
	[======================================	_	00	325us/sten	_	lossi	14 5111
	214/500		03	020u3/ 3ccp		1033.	14.0111
•	[========]	-	0s	358us/step	-	loss:	14.5768
Epoch	215/500			·			
	[=======]	-	0s	356us/step	-	loss:	14.5030
	216/500					_	
	[======================================	-	0s	333us/step	-	loss:	14.5310
	217/500 [=========]		0.0	226us/ston		1000:	1/ /500
	218/500	_	03	320u3/3cep	_	1033.	14.4303
•	[========]	_	0s	357us/step	_	loss:	14.4061
	219/500			•			
80/80	[======]	-	0s	324us/step	-	loss:	14.4033
	220/500						
	[=======]	-	0s	338us/step	-	loss:	14.4463
	221/500		00	24240/0+00		10001	14 4001
	[=====================================	-	05	342uS/Step	-	1088:	14.4031
	[=========]	_	05	332us/sten	_	lossi	14 3267
	223/500		00	002 437 3 ccp		10001	1410201
	[========]	-	0s	332us/step	-	loss:	14.3105
Epoch	224/500						
	[======]	-	0s	326us/step	-	loss:	14.2982
	225/500		•	004 - 1		1	44.005=
	[======================================	-	٥s	324us/step	-	TOSS:	14.2965
	226/500 [===================================	_	00	316us/stan	_	1066.	14 2429
	227/500	_	U.S	01003/316β	_	TO32.	17.2420
ax]/extensio							

80/80	[========]	_	0s	330us/step	_	loss:	14.2102
	228/500						
	[======]	-	0s	331us/step	-	loss:	14.1952
	229/500			/ .			
	[=====================================	-	0s	322us/step	-	loss:	14.2338
	[======================================	_	00	32711s/sten	_	1000	1/ 1622
	231/500		03	327u373ccp		1033.	14.1022
	[======================================	-	0s	335us/step	-	loss:	14.1183
	232/500						
	[======]	-	0s	343us/step	-	loss:	14.0947
	233/500 [===================================		00	22440/0400		10001	14 0047
	234/500	-	08	324uS/Step	-	1055:	14.0947
	[======================================	_	0s	335us/step	_	loss:	14.0617
Epoch	235/500			·			
	[======]	-	0s	340us/step	-	loss:	14.0603
	236/500					_	
	[======================================	-	0s	334us/step	-	loss:	14.0708
	237/500 [===========]	_	00	32711s/sten	_	1000	1/ 01/6
	238/500		03	327u373ccp		1033.	14.0140
	[=======]	_	0s	330us/step	-	loss:	13.9837
Epoch	239/500						
	[=======]	-	0s	349us/step	-	loss:	13.9695
	240/500		0.0	222		1	10 0004
	[=====================================	-	θS	322us/step	-	TOSS:	13.9824
	[======================================	_	0s	334us/step	_	loss:	13.9218
	242/500		•	33 . a.g, a cap			
80/80	[======]	-	0s	338us/step	-	loss:	13.9785
	243/500					_	
	[========]	-	0s	962us/step	-	loss:	13.8849
	244/500 [=========]		0.0	240us/ston		10001	12 9605
	245/500	_	03	549u3/3cep	_	1033.	13.0003
	[======================================	_	0s	354us/step	-	loss:	13.8301
•	246/500						
	[=========]	-	0s	362us/step	-	loss:	13.8133
	247/500 [===================================		00	247110/0100		10001	10 0650
	248/500	-	08	34/us/step	-	1055:	13.8053
	[=========]	_	0s	383us/step	_	loss:	13.7886
	249/500			оттак оттак			
	[======]	-	0s	394us/step	-	loss:	13.7730
•	250/500						
	[=====================================	-	0s	349us/step	-	loss:	13.7863
	[======================================	_	0s	354us/sten	_	loss:	13.7224
	252/500		•	30 .407 525p		10001	1011121
80/80	[=======]	-	0s	339us/step	-	loss:	13.7336
	253/500						
	[======================================	-	0s	331us/step	-	loss:	13.7458
	254/500 [===================================		0.0	220115/6400		10001	12 6557
	255/500	_	05	339u5/5tep	-	1055.	13.0337
	[=========]	_	0s	326us/step	_	loss:	13.6334
Epoch	256/500						
	[======]	-	0s	354us/step	-	loss:	13.6190
	257/500		•	0.40 (-1		10	40 0404
	[=====================================	-	⊍S	340US/STEP	-	TOSS:	13.0161
	[======================================	_	0.5	331us/sten	_	1055:	13.6017
Fnoch	259/500						
ax]/extensio	ns/Safe.js						

80/80	[=======]	_	0s	306us/step	_	loss:	13.5515
	260/500		•				
80/80	[=======]	-	0s	626us/step	-	loss:	13.5460
	261/500						
	[======]	-	0s	539us/step	-	loss:	13.5258
	262/500					-	
	[======================================	-	0s	646us/step	-	loss:	13.5415
	263/500 [===================================		0.0	246us/stop		10001	10 /055
	264/500	-	05	340us/step	-	1055.	13.4000
	[======================================	_	05	336us/sten	_	lossi	13 4818
	265/500		•	000 407 000p		1000.	101.010
	[========]	-	0s	343us/step	-	loss:	13.5073
•	266/500						
	[======]	-	0s	451us/step	-	loss:	13.4828
	267/500					-	
	[=========]	-	0s	336us/step	-	loss:	13.4288
	268/500 [===================================		00	222110/0400		10001	10 4670
	269/500	-	05	332uS/Step	-	1055:	13.4672
	[======================================	_	0s	358us/sten	_	loss:	13.3870
	270/500		•	200as, 5csp			
	[=======]	-	0s	352us/step	-	loss:	13.3821
Epoch	271/500						
	[======]	-	0s	1ms/step -	10	oss: 13	3.3717
	272/500		_			-	
	[======================================	-	0s	453us/step	-	loss:	13.3932
	273/500 [=========]		0.0	254uc/cton		10001	10 0070
	274/500	-	05	354uS/Step	-	1055.	13.3376
	[========]	_	05	388us/sten	_	loss	13 3360
	275/500		00	000и3/ 3сер		10001	1010000
80/80	[=======]	-	0s	357us/step	-	loss:	13.3276
Epoch	276/500						
	[======]	-	0s	369us/step	-	loss:	13.2925
	277/500					-	
	[======================================	-	0s	367us/step	-	loss:	13.2670
	278/500 [========]		0.0	262us/ston		10001	12 2022
	279/500	_	03	302us/step	-	1055.	13.3023
	[======================================	_	0s	331us/step	_	loss:	13,2651
	280/500						
80/80	[=======]	-	0s	335us/step	-	loss:	13.2120
	281/500						
	[======]	-	0s	350us/step	-	loss:	13.2032
	282/500		0 -	050 /		1	10 1000
	[=====================================	-	0S	353us/step	-	loss:	13.1638
	[======================================	_	05	352us/sten	_	loss	13 1424
	284/500		03	332 437 3 CCP		1033.	10.1424
	[=======]	_	0s	350us/step	_	loss:	13.1451
	285/500			•			
	[=======]	-	0s	337us/step	-	loss:	13.1666
	286/500						
	[========]	-	0s	352us/step	-	loss:	13.1551
	287/500 [=========]		00	220110/0400		10001	10 1007
	288/500	-	US	asans/sreb	-	TO22;	13.123/
	[======================================	_	0.5	319us/sten	_	1055	13.1021
	289/500		55	3_240/000р		_555.	
	[========]	-	0s	318us/step	-	loss:	13.0934
	290/500			·			
	[======]	-	0s	329us/step	-	loss:	13.0392
Fnoch ax]/extension	291 / 500 ns/Safe is						
~,r < ^ to 1 13101	nor-caro.jo						

80/80	[=======]	-	0s	327us/step	_	loss:	13.0762
	292/500						
	[======]	-	0s	323us/step	-	loss:	13.0105
	293/500		_				
	[=====================================	-	0s	323us/step	-	loss:	13.0123
	[======================================	_	00	32011s/sten	_	1000	13 03/1
	295/500		03	323u373tcp		1033.	13.0341
	[========]	-	0s	316us/step	-	loss:	12.9728
	296/500						
	[=======]	-	0s	331us/step	-	loss:	13.0308
	297/500 [=========]		0.0	21 Fue /etop		10001	12 0560
	298/500	-	08	315uS/Step	-	1055:	12.9500
	[=========]	_	0s	312us/step	_	loss:	12.9698
Epoch	299/500			·			
	[======]	-	0s	318us/step	-	loss:	12.9340
	300/500					_	
	[======================================	-	0s	318us/step	-	loss:	12.9473
	301/500 [==========]	_	00	318us/stan	_	10001	12 001/
	302/500	_	03	310u3/31ep	-	1055.	12.9014
	[========]	_	0s	328us/step	_	loss:	12.9242
Epoch	303/500						
	[======]	-	0s	331us/step	-	loss:	12.8836
	304/500		_				
	[======================================	-	0s	316us/step	-	loss:	12.8655
	305/500 [===================================	_	00	302us/sten	_	1000	12 8/130
	306/500		03	302u3/31cp		1033.	12.0433
	[=======]	-	0s	494us/step	_	loss:	12.8173
Epoch	307/500						
	[=======]	-	0s	459us/step	-	loss:	12.8025
	308/500 [===================================		0.0	242/atan		1	10 0001
	309/500	-	ΘS	342uS/Step	-	1088:	12.8001
	[======================================	_	0s	333us/step	_	loss:	12.8110
	310/500						
	[======]	-	0s	327us/step	-	loss:	12.7649
	311/500		_				
	[======================================	-	0s	315us/step	-	loss:	12.7550
	312/500 [===================================	_	00	328us/sten	_	1000	12 7536
	313/500		03	320u3/31cp		1033.	12.7330
	[=========]	-	0s	322us/step	-	loss:	12.8221
•	314/500						
	[=======]	-	0s	323us/step	-	loss:	12.7318
	315/500 [===================================		0.0	221110/0400		10001	10 7000
	316/500	-	08	321uS/Step	-	1055:	12.7230
	[==========]	_	0s	325us/sten	_	loss:	12.7076
	317/500			о			
	[======]	-	0s	315us/step	-	loss:	12.7034
	318/500					_	
	[======================================	-	0s	329us/step	-	loss:	12.7568
	319/500 [===================================	_	00	32/11c/cton	_	10001	12 6010
	320/500		U.S	52-403/31Eβ		T0331	TC:03T3
	[=======]	-	0s	319us/step	-	loss:	12.6381
Epoch	321/500						
	[=======]	-	0s	318us/step	-	loss:	12.6571
	322/500		0.5	240.00 /55-		100	10 0000
	[=====================================	-	US	этапг/steb	-	TOSS:	12.0032
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	[========]	-	0S	315us/step	-	LOSS:	12.6038
∟poch	324/500						
	[======]	-	0s	331us/step	-	loss:	12.6218
	325/500		_			-	
	[=====================================	-	0s	310us/step	-	loss:	12.5923
	[======================================	_	00	32/11s/sten	_	10881	12 61/15
	327/500		03	324u3/3ccp		1033.	12.0143
	[========]	-	0s	325us/step	-	loss:	12.5784
	328/500						
	[======]	-	0s	319us/step	-	loss:	12.5439
	329/500 [========]		00	207112/2122		10001	10 6006
	330/500	-	08	30/us/step	-	1088:	12.0380
	[======================================	_	0s	318us/step	_	loss:	12.5161
Epoch	331/500						
	[======]	-	0s	309us/step	-	loss:	12.5485
	332/500					_	
	[======================================	-	0s	332us/step	-	loss:	12.5139
	333/500 [===========]	_	00	212us/stan	_	1000	12 /660
	334/500	_	03	312u3/31ep	_	1055.	12.4000
	[=========]	_	0s	339us/step	_	loss:	12.4951
Epoch	335/500						
	[======]	-	0s	318us/step	-	loss:	12.4645
	336/500		_			-	
	[======================================	-	0s	331us/step	-	loss:	12.4911
	337/500 [========]	_	00	326us/sten	_	10881	12 /681
	338/500		03	320u3/31cp		1033.	12.4001
	[=======]	-	0s	341us/step	_	loss:	12.4347
Epoch	339/500						
	[======]	-	0s	332us/step	-	loss:	12.4363
	340/500		0 -	0.40		1	10 1000
	[=====================================	-	ΘS	342us/step	-	TOSS:	12.4062
	[======================================	_	0s	321us/step	_	loss:	12.4401
	342/500						
80/80	[=======]	-	0s	324us/step	-	loss:	12.3709
	343/500					_	
		-	0s	517us/step	-	loss:	12.3992
	344/500 [==========]		0.0	20Euc/cton		10001	12 2000
	345/500	-	05	305uS/Step	-	1055.	12.3900
	[======================================	_	0s	414us/step	_	loss:	12.3430
Epoch	346/500						
	[======]	-	0s	394us/step	-	loss:	12.3754
	347/500		•	0.10		1	10 0101
	[=========] 348/500	-	0S	346us/step	-	TOSS:	12.3421
•	[======================================	_	00	342us/sten	_	10881	12 3162
	349/500		00	0+2u3/3ccp		10001	12.0102
	[=======]	-	0s	344us/step	-	loss:	12.3067
	350/500						
	[======]	-	0s	371us/step	-	loss:	12.2896
	351/500 [========]		0.0	270112/2+22		10001	12 2024
	352/500	-	US	orous/step	-	T022;	12.2924
	[======================================	_	0s	348us/sten	_	loss:	12.2839
Epoch	353/500						
	[======]	-	0s	356us/step	-	loss:	12.2811
	354/500		_				
	[=====================================	-	0s	380us/step	-	loss:	12.2516
	ns/Safe.js						

80/80	[========]	_	0s	362us/step	_	loss:	12.2614
	356/500						
	[======]	-	0s	647us/step	-	loss:	12.2595
	357/500		_				
	[======================================	-	0s	376us/step	-	loss:	12.2139
	358/500 [===================================	_	00	38111s/sten	_	1066.	12 2/15/
	359/500		03	301и3/31ср		1033.	12.2454
	[========]	-	0s	377us/step	-	loss:	12.2338
	360/500						
	[======]	-	0s	374us/step	-	loss:	12.2051
	361/500 [=========]		00	271110/0+00		10001	10 0001
	362/500	-	08	3/Ius/step	-	1088:	12.2021
	[========]	_	0s	380us/step	_	loss:	12.2314
Epoch	363/500						
	[======]	-	0s	373us/step	-	loss:	12.1907
	364/500					_	
	[======================================	-	0s	338us/step	-	loss:	12.1666
	365/500 [========]	_	00	3/3/16/stan	_	1000	12 1582
	366/500	_	03	343u3/31ep	-	1055.	12.1302
	[========]	_	0s	364us/step	_	loss:	12.1490
Epoch	367/500						
	[======]	-	0s	341us/step	-	loss:	12.1477
	368/500		_				
	[======================================	-	0s	337us/step	-	loss:	12.1319
	369/500 [===================================	_	00	3/3/15/sten	_	1066.	12 1360
	370/500		03	545и3/ 3сер		1033.	12.1300
	[=========]	-	0s	341us/step	_	loss:	12.0908
Epoch	371/500						
	[======]	-	0s	320us/step	-	loss:	12.1246
	372/500		0 -	000		1	40 4054
	[=====================================	-	ΘS	328us/step	-	TOSS:	12.1351
	[======================================	_	0s	326us/step	_	loss:	12.0812
	374/500			о			
80/80	[=======]	-	0s	496us/step	-	loss:	12.1255
	375/500					_	
	[======================================	-	0s	478us/step	-	loss:	12.0700
	376/500 [=========]		0.0	222115/5400		10001	12 0020
	377/500	-	05	322uS/Step	-	1055.	12.0030
	[========]	_	0s	336us/step	_	loss:	12.1103
Epoch	378/500						
	[======]	-	0s	347us/step	-	loss:	12.0442
	379/500						
	[========] 380/500	-	0s	345us/step	-	Toss:	12.0295
	[======================================	_	00	33011s/sten	_	1066.	12 0307
	381/500		03	555437 3 с с р		1033.	12.0007
	[======================================	-	0s	341us/step	-	loss:	12.0328
	382/500						
	[======]	-	0s	318us/step	-	loss:	12.0156
	383/500		0.0	256up/ota-		1000:	10 0000
	[=========] 384/500	-	US	350US/STEP	-	TOSS:	12.0322
	[======================================	_	0°	335us/sten	_	1055	12.0006
	385/500		55	20040, 3сор		10001	12.0000
80/80	[======]	-	0s	341us/step	-	loss:	11.9969
	386/500					_	
	[=====================================	-	0s	331us/step	-	loss:	11.9641
Enocn ax]/extensio							
-	-						

80/80	[=======]	_	0s	340us/step	_	loss:	11.9736
	388/500			3 . 3 a 5 , 5 c 5 p			
80/80	[=======]	-	0s	351us/step	-	loss:	11.9576
	389/500						
	[======]	-	0s	350us/step	-	loss:	11.9562
	390/500						
	[======================================	-	0s	351us/step	-	loss:	11.9455
	391/500 [=========]		0.0	261uc/stop		10001	11 0/05
	392/500	-	05	20102/216h	-	1055.	11.9403
	[=========]	_	0.5	345us/sten	_	lossi	11 9502
	393/500		•	0.0d0/0c0p		10001	11.0002
	[========]	-	0s	350us/step	-	loss:	11.9097
	394/500						
	[======]	-	0s	335us/step	-	loss:	11.9212
	395/500			, ,			
	[======================================	-	0s	332us/step	-	loss:	11.9053
	396/500 [=========]		0.0	2E1uc/ctop		10001	11 0021
	397/500	-	05	35102/2reh	-	1055.	11.9021
	[=========]	_	0s	343us/sten	_	loss:	11.8801
	398/500			C.Cas, 5csp			
80/80	[=======]	-	0s	335us/step	-	loss:	11.8713
Epoch	399/500						
	[======]	-	0s	363us/step	-	loss:	11.9005
	400/500						
	[=======]	-	0s	324us/step	-	loss:	11.8946
	401/500 [=============]		0.0	222115/5400		10001	11 00/12
	402/500	-	05	322uS/Step	-	1055.	11.0042
	[========]	_	05	343us/sten	_	loss:	11.8670
	403/500		•	0.10 407 020p		1000.	11.00.0
80/80	[=======]	-	0s	331us/step	-	loss:	11.8582
Epoch	404/500						
	[======]	-	0s	325us/step	-	loss:	11.8365
	405/500			, ,			
	[======================================	-	0s	329us/step	-	loss:	11.8462
•	406/500		0.0	226us/ston		10001	11 0117
	407/500	-	03	320u3/3tep	_	1055.	11.011/
	[======================================	_	0s	319us/step	_	loss:	11.8320
	408/500						
80/80	[=======]	-	0s	329us/step	-	loss:	11.8101
	409/500						
	[======]	-	0s	344us/step	-	loss:	11.7946
•	410/500		0 -	000		1	44 0404
	[=====================================	-	٥s	336us/step	-	TOSS:	11.8104
	[======================================	_	00	379us/sten	_	10881	11 8108
	412/500		03	07 3 d 37 3 c c p		1033.	11.0100
	[=======]	_	0s	329us/step	_	loss:	11.7755
	413/500			•			
80/80	[=======]	-	0s	334us/step	-	loss:	11.7761
	414/500						
	[========]	-	0s	332us/step	-	loss:	11.7741
	415/500 [=============]		0.0	252110/0+00		10001	11 7560
	416/500	-	US	oo∠us/steβ	-	TO22:	11.7209
	[======================================	_	0.5	338us/sten	_	1055	11.7574
	417/500		55	эээдэ, эсор		_555.	
	[=======]	-	0s	321us/step	-	loss:	11.7465
	418/500						
	[======]	-	0s	328us/step	-	loss:	11.7584
Fnoch ax]/extensio	419/500 ns/Safe is						
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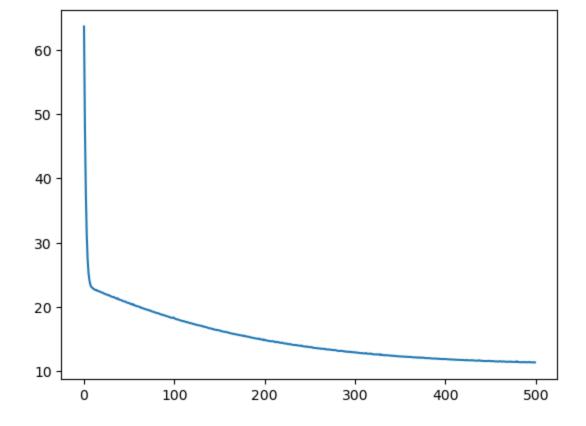
80/80	[========]	_	0s	322us/step	_	loss:	11.7466
	420/500		•	0 a, 0 cop			
80/80	[=======]	-	0s	405us/step	-	loss:	11.7361
	421/500						
	[========]	-	0s	591us/step	-	loss:	11.7230
	422/500			, ,			
	[==========]	-	0s	365us/step	-	loss:	11.7270
	423/500 [===================================		0.0	2E2uc/stop		10001	11 7101
	424/500	-	05	352uS/Step	-	1055.	11.7191
	[========]	_	05	358us/sten	_	lossi	11 6914
	425/500		•	000 do, 000 p		10001	11.001.
	[=======]	-	0s	366us/step	-	loss:	11.7537
Epoch	426/500						
	[======]	-	0s	347us/step	-	loss:	11.6881
	427/500					_	
	[========]	-	0s	347us/step	-	loss:	11.6859
	428/500		00	24542/2522		10001	11 6004
	[=====================================	-	ΘS	345us/step	-	TOSS:	11.6834
	[======================================	_	00	339us/sten	_	10881	11 6798
	430/500		03	3334373tcp		1033.	11.0730
	[========]	_	0s	325us/step	_	loss:	11.7117
Epoch	431/500						
80/80	[======]	-	0s	318us/step	-	loss:	11.6818
	432/500						
	[======]	-	0s	315us/step	-	loss:	11.6652
	433/500		•	045 - /-1		1	44 0505
	[=====================================	-	0S	315us/step	-	TOSS:	11.6525
	[======================================		0.0	219us/ston		10001	11 6/25
	435/500	_	03	31002/21eh	_	1055.	11.0433
	[======================================	_	0s	312us/step	_	loss:	11.6425
	436/500			ошини, отор			
80/80	[=======]	-	0s	318us/step	-	loss:	11.6290
	437/500						
	[=======]	-	0s	319us/step	-	loss:	11.6284
	438/500			, ,			
	[==========]	-	0s	330us/step	-	loss:	11.6963
	439/500 [===================================	_	۵e	222115/stan	_	10001	11 6/68
	440/500		03	322u3/3tep		1033.	11.0400
	[=======]	_	0s	315us/step	_	loss:	11.6206
	441/500						
80/80	[=======]	-	0s	317us/step	-	loss:	11.6320
•	442/500						
	[=======]	-	0s	315us/step	-	loss:	11.5866
	443/500		0 -	500 /a.t.a.a		1	44 5707
	[=====================================	-	ΘS	528us/step	-	TOSS:	11.5/9/
	[======================================		0.0	472us/ston		10001	11 5707
	445/500	_	03	472u373tep	_	1055.	11.5767
	[==========]	_	0s	354us/step	_	loss:	11.5849
	446/500			•			
80/80	[=======]	-	0s	330us/step	-	loss:	11.5579
	447/500						
	[========]	-	0s	345us/step	-	loss:	11.5837
	448/500		•	0.47		1	44 ====
	[======================================	-	٥s	34/us/step	-	TOSS:	11.5877
	449/500 [============]	_	00	35111e/etan	_	1066.	11 6021
	450/500		U 3	55±α5/315β		1033.	TT.0001
	[=======]	_	0s	334us/step	_	loss:	11.5683
Fnoch	451/500			r			
ax]/extensio	ns/Safe.js						

	[=========]	-	0s	328us/step	-	LOSS:	11.5826
	452/500						
	[======]	-	0s	321us/step	-	loss:	11.5382
	453/500		_	/ .		-	
	[=====================================	-	0s	320us/step	-	loss:	11.5673
•	[=========]	_	00	3//us/sten	_	10881	11 5607
	455/500		03	544и3/ 3сер		1033.	11.5007
	[========]	-	0s	317us/step	-	loss:	11.5282
	456/500						
	[======]	-	0s	350us/step	-	loss:	11.5099
	457/500 [========]		00	24240/0+00		10001	11 [017
	[========] 458/500	-	08	342uS/Step	-	1088:	11.5217
	[======================================	_	0s	322us/step	_	loss:	11.5046
Epoch	459/500						
	[======]	-	0s	317us/step	-	loss:	11.5165
	460/500					_	
	[======================================	-	0s	323us/step	-	loss:	11.5053
	461/500 [=========]	_	00	215us/stan	_	1000	11 5221
	462/500	_	03	313u3/31ep	_	1055.	11.5251
	[========]	_	0s	314us/step	_	loss:	11.5537
Epoch	463/500						
	[=====]	-	0s	320us/step	-	loss:	11.4953
	464/500		_			-	
	[======================================	-	0s	316us/step	-	loss:	11.4790
	465/500 [===================================	_	00	31711s/sten	_	10881	11 5162
	466/500		03	517и3/3сср		1033.	11.5102
	[=======]	_	0s	334us/step	_	loss:	11.5177
Epoch	467/500						
	[======]	-	0s	322us/step	-	loss:	11.4743
	468/500		0 -	000		1	44 4000
	[=====================================	-	ΘS	332us/step	-	TOSS:	11.4606
	[======================================	_	0s	326us/step	_	loss:	11.4683
	470/500			о			
80/80	[=======]	-	0s	329us/step	-	loss:	11.4583
	471/500					_	
	[======================================	-	0s	346us/step	-	loss:	11.4578
	472/500 [========]		0.0	225110/0400		10001	11 4602
	473/500	-	05	325uS/Step	-	1055.	11.4002
	[======================================	_	0s	327us/step	_	loss:	11.5032
Epoch	474/500						
	[======]	-	0s	326us/step	-	loss:	11.4494
	475/500		•	000 - (-)		1	45.00
	[=====================================	-	0S	323us/step	-	TOSS:	11.4503
	[======================================	_	00	347us/sten	_	10881	11 4307
	477/500		00	047 из/ эсер		10001	1114001
	[======]	-	0s	337us/step	-	loss:	11.4561
	478/500						
	[======]	-	0s	331us/step	-	loss:	11.4407
	479/500 [========]		0.0	220110/0400		10001	11 4010
	[=====================================	-	US	ssous/step	-	T022;	11.4313
	[======================================	_	0s	328us/sten	_	loss:	11.5428
Epoch	481/500						
	[======]	-	0s	322us/step	-	loss:	11.4111
	482/500		_				
	[=====================================	-	0s	321us/step	-	loss:	11.4236

```
Epoch 484/500
80/80 [============= ] - 0s 322us/step - loss: 11.4056
Epoch 485/500
Epoch 486/500
80/80 [============= ] - 0s 338us/step - loss: 11.4122
Epoch 487/500
80/80 [=============== ] - 0s 315us/step - loss: 11.4055
Epoch 488/500
Epoch 489/500
80/80 [============== ] - 0s 331us/step - loss: 11.3859
Epoch 490/500
Epoch 491/500
Epoch 492/500
Epoch 493/500
80/80 [============= ] - 0s 309us/step - loss: 11.4278
Epoch 494/500
80/80 [============= ] - 0s 326us/step - loss: 11.3877
Epoch 495/500
Epoch 496/500
80/80 [=============== ] - 0s 432us/step - loss: 11.3716
Epoch 497/500
Epoch 498/500
80/80 [============= ] - 0s 327us/step - loss: 11.3785
Epoch 499/500
Epoch 500/500
80/80 [============== ] - 0s 326us/step - loss: 11.3610
```

Use the training history to plot how the loss function changed over each training epoch.

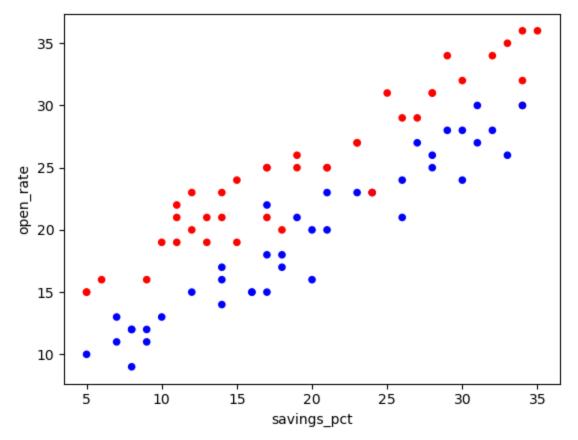
```
In [17]:
         # put your answer here
         plt.plot(history.history['loss'])
         [<matplotlib.lines.Line2D at 0x2875a87c0>]
```



What equation does the model provide for predicting open rate?

```
In [18]:
         model.get_weights()
         w0 = model.get_weights()[1]
         w1 = model.get_weights()[0]
         print("equation: student_acquired = %.2f + %.2f * first_class_price"%(w0,w1))
In [19]:
         equation: student_acquired = 7.28 + 0.75 * first_class_price
In [20]:
          x[0:3]
         array([[32],
Out[20]:
                 [25],
                 [17]])
         y[0:3]
In [21]:
         array([[34],
Out[21]:
                 [31],
                 [25]])
         y_pred = w0+w1*x
In [22]:
          y_pred[0:3]
         array([[31.19114971],
Out[22]:
                 [25.96159953],
                 [19.98497075]])
         put your answer here
```

Now, let's repeat the whole exercise, but add <code>coupon_or_discount</code> as our second predictor. To start, create a scatterplot of <code>savings_pct</code> vs <code>open_rate</code> with each dot a different colour depending on the value of <code>coupon_or_discount</code>.



Question 13

Recreate x to include both savings_pct and coupon_or_discount.

```
In [24]: # put your answer here
x = df[['savings_pct','coupon_or_discount']].to_numpy()
```

Question 14

Redefine input, linear_regression, and model to accommodate our new predictor.

```
In [25]: # put your answer here
  input = keras.Input(shape=(2))
In [26]: linear_regression = keras.layers.Dense(1)(input)
```

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```
In [27]: model = keras.Model(inputs=input, outputs=linear_regression)
In [28]: model.compile(optimizer='adam', loss='mean_squared_error')
```

Compile the new model and train it for 500 epochs on a batch size of 1. Make sure to save the model history: we'll use it in the next question.

```
In [29]: # put your answer here
history = model.fit(x,y,batch_size=1,epochs=500)
```

	1/500						
	[=========] 2/500	-	0s	470us/step	-	loss:	29.1803
	[=========]	_	0s	332us/step	_	loss:	28.0849
Epoch	3/500			·			
	[======================================	-	0s	347us/step	-	loss:	27.5573
	4/500 [========]	_	0s	358us/step	_	loss:	27.1881
Epoch	5/500						
		-	0s	351us/step	-	loss:	26.8859
	6/500 [=======]	_	00	370us/sten	_	10881	26 6170
	7/500		03	57 0037 3 CCP		10331	20.0170
	[======]	-	0s	409us/step	-	loss:	26.3423
	8/500 [========]		0.0	360us/stan	_	10001	26 1127
	9/500	_	03	300us/step	_	1055.	20.1137
	[=====]	-	0s	350us/step	-	loss:	25.8961
	10/500		0.0	20200 (2522		1	05 7467
	[=========] 11/500	-	ΘS	363uS/Step	-	1088:	25.7467
	[========]	-	0s	362us/step	-	loss:	25.3959
	12/500						
	[=========] 13/500	-	0s	364us/step	-	loss:	25.2708
	[======================================	-	0s	397us/step	_	loss:	24.9196
	14/500						
	[=====================================	-	0s	369us/step	-	loss:	24.6812
	[======================================	_	0s	346us/step	_	loss:	24.4673
Epoch	16/500						
	[========]	-	0s	362us/step	-	loss:	24.2643
	17/500 [========]	_	05	337us/sten	_	1055:	24.0198
Epoch	18/500						
	[=======]	-	0s	372us/step	-	loss:	23.8036
	19/500 [==========]	_	05	345us/sten	_	1055	23 6278
	20/500		00	0-10007 осер		10001	2010210
	[======]	-	0s	348us/step	-	loss:	23.3692
	21/500 [==========]	_	0.0	3/10us/stan	_	10001	22 1028
	22/500	_	03	343u3/3tep	_	1033.	23.1920
80/80	[======]	-	0s	347us/step	-	loss:	22.9965
	23/500 [==========]		0.0	24000 (ctop		10001	22 7122
	24/500	-	05	340us/step	-	1055.	22.7123
80/80	[======]	-	0s	346us/step	-	loss:	22.4907
	25/500		00	24540/0400		10001	22 2002
	[=====================================	-	08	345uS/Step	-	1055:	22.2802
	[======================================	-	0s	345us/step	-	loss:	22.0501
	27/500		•	000 - (-)		1	04 0450
	[=====================================	-	ΘS	382us/step	-	TOSS:	21.9456
	[======================================	-	0s	358us/step	_	loss:	21.6683
	29/500					_	
	[=======] 30/500	-	0s	321us/step	-	loss:	21.4372
	[======================================	-	0s	370us/step	-	loss:	21.2614
Epoch	31/500			·			
	[========] 32/500	-	0s	342us/step	-	loss:	21.0383
80/80	32/500 _[===================================	_	0s	345us/sten	_	loss:	20.8669
x]/extensio	ns/Safe.js		-				

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	33/500					_	
	[========] 34/500	-	0s	356us/step	-	loss:	20.6516
	[=========]	-	0s	372us/step	-	loss:	20.4914
	35/500		0 -	050/		1	00 0004
	[========] 36/500	-	ΘS	350us/step	-	1088:	20.2364
	[======================================	-	0s	342us/step	-	loss:	20.0427
	37/500		•	000 - (-1		1	10 0100
	[=========] 38/500	-	0S	368us/step	-	loss:	19.9189
	[========]	-	0s	470us/step	_	loss:	19.6951
	39/500					-	
	[=====================================	-	0S	353us/step	-	IOSS:	19.5079
	[=========]	-	0s	317us/step	_	loss:	19.3143
Epoch	41/500						
	[=====================================	-	0s	347us/step	-	loss:	19.1679
	[======================================	_	0s	345us/step	_	loss:	18.9190
Epoch	43/500						
	[======================================	-	0s	349us/step	-	loss:	18.8145
	44/500 [==========]	_	0s	342us/sten	_	loss:	18.5432
Epoch	45/500						
		-	0s	534us/step	-	loss:	18.3860
	46/500 [==========]	_	0 c	160us/sten	_	1000	18 2110
Epoch	47/500						
	[======]	-	0s	339us/step	-	loss:	18.0280
	48/500 [========]		0.0	246uc/cton		10001	17 0067
	49/500	-	05	340us/step	-	1055.	17.9007
80/80	[======]	-	0s	331us/step	-	loss:	17.6954
	50/500 [==========]		0.0	261440 / 0 + 0 2		10001	17 [100
	51/500	-	05	20102/2reh	-	1055.	17.5103
80/80	[======]	-	0s	342us/step	-	loss:	17.3304
	52/500 [==========]		0.0	26042/2422		10001	17 1515
	53/500	-	05	360us/step	-	1055.	17.1515
	[======]	-	0s	339us/step	-	loss:	16.9908
	54/500		0 -	0.40/		1	10 0001
	[=====================================	-	ΘS	343us/step	-	1088:	16.8221
	[========]	-	0s	332us/step	-	loss:	16.6634
	56/500		•	000 - (-1		1	40 4705
	[=====================================	-	0S	338us/step	-	IOSS:	16.4/35
	[======================================	-	0s	321us/step	-	loss:	16.3302
	58/500					_	
	[=====================================	-	0s	336us/step	-	loss:	16.1845
	[==========]	-	0s	332us/step	_	loss:	15.9964
Epoch	60/500						
	[=====================================	-	0s	325us/step	-	loss:	15.8368
	[======================================	_	0s	332us/step	_	loss:	15.7154
Epoch	62/500						
	[======================================	-	0s	322us/step	-	loss:	15.5758
	63/500 [========]	_	0s	334us/step	_	loss:	15.3994
Epoch	64/500			·			
80/80 x]/extensio	rs/Safe.js	-	0s	337us/step	-	loss:	15.2484
	•						

	65/500						
	[=====================================	-	0s	332us/step	-	loss:	15.0546
	[======================================	-	0s	331us/step	-	loss:	14.9342
	67/500		0.0	222		1	14 7050
	[=====================================	-	ΘS	322us/step	-	1055:	14.7656
	[======================================	-	0s	324us/step	-	loss:	14.6631
	69/500		•	005 - /-1		1	44 4047
	[=====================================	-	0S	325us/step	-	loss:	14.4947
	[========]	-	0s	328us/step	_	loss:	14.3812
	71/500						
	[=====================================	-	0s	324us/step	-	loss:	14.1612
	[=========]	_	0s	322us/step	_	loss:	14.0431
	73/500						
	[======================================	-	0s	339us/step	-	loss:	13.9011
	74/500	_	0s	339us/step	_	loss:	13.7629
Epoch	75/500						
	[=======]	-	0s	344us/step	-	loss:	13.6369
	76/500 [==========]	_	00	356us/stan		10001	12 /127/
	77/500	_	03	330u3/31ep	_	1033.	13.4074
80/80	[======]	-	0s	327us/step	-	loss:	13.3465
	78/500 [=========]		0.0	22642/2422		10001	10 0044
	79/500	-	08	326uS/Step	-	1055:	13.2344
	[=========]	-	0s	324us/step	-	loss:	13.1002
	80/500						
	[=====================================	-	0s	334us/step	-	loss:	12.9516
	[=======]	-	0s	336us/step	_	loss:	12.8526
Epoch	82/500						
	[=====================================	-	0s	345us/step	-	loss:	12.6866
	[======================================	_	0s	344us/step	_	loss:	12.5675
Epoch	84/500						
	[======================================	-	0s	373us/step	-	loss:	12.4422
	85/500 [=========]	_	0s	339us/step	_	loss:	12.2893
Epoch	86/500						
	[======================================	-	0s	344us/step	-	loss:	12.1821
	87/500 [=========]	_	05	335us/sten	_	1055'	12 0816
	88/500		00	333 437 523 p		10001	12.0010
	[=======]	-	0s	363us/step	-	loss:	11.9201
	89/500 [=========]	_	Θs	32711s/sten	_	1000	11 82/18
	90/500		03	327u373tep	_	1033.	11.0240
80/80	[======]	-	0s	321us/step	-	loss:	11.7064
	91/500 [==========]		0.0	24000 (0100		10001	11 5560
	92/500	-	05	340us/step	-	1055.	11.5569
	[========]	-	0s	331us/step	-	loss:	11.4474
	93/500		0.0	22000 / 2 + 2 2		1	11 0000
	[=====================================	-	0S	336us/step	-	1088:	11.3332
	[======================================	-	0s	332us/step	-	loss:	11.2180
	95/500		•	000/		1	44 4500
	[=====================================	-	٥s	329us/step	-	TOSS:	11.1583
80/80	<u>Г======</u>	-	0s	338us/step	-	loss:	10.9920
x]/extensio	ns/Safe.js			·			

	97/500		_			,	
	[=====================================	-	0S	329us/step	-	loss:	10.9128
80/80	[======]	-	0s	445us/step	-	loss:	10.7596
	99/500 [==========]	_	0s	452us/step	_	loss:	10.6684
Epoch	100/500						
	[=========] 101/500	-	0s	392us/step	-	Toss:	10.5582
80/80	[======]	-	0s	346us/step	-	loss:	10.4534
	102/500 [==========]	_	0s	313us/step	_	loss:	10.3488
Epoch	103/500						
	[=========] 104/500	-	0s	320us/step	-	Toss:	10.2601
80/80	[======]	-	0s	351us/step	-	loss:	10.1173
	105/500 [==========]	_	0s	330us/step	_	loss:	10.0285
Epoch	106/500			·			
	[========] 107/500	-	0s	329us/step	-	loss:	9.9287
80/80	[======]	-	0s	344us/step	-	loss:	9.8196
	108/500 [==========]	_	<u>ര</u> ം	33511s/sten	_	10881	0 7287
Epoch	109/500						
	[========] 110/500	-	0s	331us/step	-	loss:	9.6440
	[======================================	-	0s	323us/step	-	loss:	9.5548
	111/500 [=========]		00	300us/stan	_	10001	0 4277
Epoch	112/500			·			
	[=====================================	-	0s	319us/step	-	loss:	9.3685
80/80	[======================================	_	0s	334us/step	-	loss:	9.2399
	114/500 [==========]		00	220112/2122		10001	0 1074
Epoch	115/500						
	[======================================	-	0s	533us/step	-	loss:	9.0562
	116/500 [==========]	_	0s	420us/step	_	loss:	9.0023
Epoch	117/500 [========]						
	118/500	-	05	339uS/Step	-	1055.	0.0921
	[======================================	-	0s	338us/step	-	loss:	8.8244
	119/500 [============]	-	0s	344us/step	-	loss:	8.7095
	120/500		0.0	220/2+25		1	0.0070
	[========] 121/500	-	US	328us/step	-	1088:	8.6378
	[======================================	-	0s	389us/step	-	loss:	8.5784
	122/500 [==========]	_	0s	333us/step	_	loss:	8.4509
Epoch	123/500						
	[=========] 124/500	-	ΰS	339us/step	-	1055:	8.4006
80/80	[======]	-	0s	344us/step	-	loss:	8.3273
	125/500 [==========]	_	0s	335us/step	_	loss:	8.2317
Epoch	126/500			·			
	[========] 127/500	-	٥S	342us/step	-	TOSS:	8.16/6
80/80	[======]	-	0s	327us/step	-	loss:	8.0622
±poch 80/80	128/500 [=======]	_	0s	325us/sten	_	loss:	8.0151
x]/extensio	ns/Safe.js		-			_	

	129/500						
	[======================================] -	0s	343us/step	-	loss:	7.9064
	130/500 [===================================	1 -	0.5	323us/sten	_	loss:	7.8371
Epoch	131/500	_		·			
] -	0s	329us/step	-	loss:	7.7680
	132/500 [===================================	1 -	0.5	332us/sten	_	lossi	7 6891
	133/500	1	03	302 437 3 CCP		1033.	7.0051
	[======================================] -	0s	324us/step	-	loss:	7.7059
	134/500 [===================================	1 _	0.0	221us/ston		10001	7 5207
	135/500] -	03	321u3/3tep	-	1055.	1.5561
	[======================================] -	0s	328us/step	-	loss:	7.4896
	136/500 [===================================	7	00	227112/2522		10001	7 4015
	137/500] -	US	32/us/step	-	1088:	7.4315
	[===========] -	0s	320us/step	-	loss:	7.3352
	138/500	,	•	007 - (-)			-
	[=====================================] -	٥s	32/us/step	-	IOSS:	7.3030
	[======================================] -	0s	331us/step	-	loss:	7.2135
	140/500	_					
	[=====================================] -	0s	329us/step	-	loss:	7.1275
	[======================================] -	0s	335us/step	_	loss:	7.0884
	142/500						
	[=====================================] -	0s	342us/step	-	loss:	7.0518
	[======================================	1 -	0s	337us/step	_	loss:	6.9523
Epoch	144/500						
	145/500] -	0s	340us/step	-	loss:	6.8845
	145/500	1 -	0s	348us/step	_	loss:	6.8810
Epoch	146/500						
	[======================================] -	0s	353us/step	-	loss:	6.8023
	147/500 [===================================	1 -	0s	385us/step	_	loss:	6.7061
Epoch	148/500						
	140/500] -	0s	386us/step	-	loss:	6.6604
	149/500	1 -	0s	338us/sten	_	loss:	6.6116
Epoch	150/500	_					
	[======================================] -	0s	327us/step	-	loss:	6.5314
	151/500 [===================================	1 -	05	328us/sten	_	loss:	6.4995
	152/500	J	00	020 437 3 CCP		10001	014000
] -	0s	332us/step	-	loss:	6.4631
	153/500 [===================================	1 -	0.5	321us/sten	_	10881	6 3779
	154/500	J	03	021u3/3ccp		1033.	0.0775
	[======================================] -	0s	465us/step	-	loss:	6.3130
	155/500 [===================================	1 _	Θs	37111c/cten	_	lneer	6 27/12
	156/500	1	03	37 1437 3 CCp		1033.	0.2742
	[======================================] -	0s	351us/step	-	loss:	6.2515
	157/500 [===================================	1 _	0.0	2/2us/ston		10001	6 1520
	158/500] _	03	343u3/3cep	_	1033.	0.1339
80/80	[======================================] -	0s	380us/step	-	loss:	6.1170
	159/500 [===================================	1	0.0	272110/0+00		locci	6 0001
Epoch	160/500	_		·			
80/80	Γ=====] -	0s	343us/step	-	loss:	6.0468
x]/extensio	115/3a18. S						

Epoch	161/500						
80/80	[=======]	-	0s	358us/step	-	loss:	5.9881
	162/500 [=======]		0.0	22440/0100		10001	F 0400
	163/500	-	08	334uS/Step	-	1055:	5.9488
	[=========]	-	0s	348us/step	-	loss:	5.8900
	164/500						
	[========] 165/500	-	0s	338us/step	-	loss:	5.8673
	[=========]	_	0s	343us/step	_	loss:	5.8042
Epoch	166/500			·			
	[======================================	-	0s	351us/step	-	loss:	5.7565
	167/500 [========]	_	0.5	339us/sten	_	1088:	5.7313
	168/500		•	200 a.g., 3 c.g.p		10001	011010
	[=======]	-	0s	348us/step	-	loss:	5.7003
	169/500 [========]		0.0	224/24.22		1	E 60E4
	170/500	-	0S	334uS/Step	-	1088:	5.6254
	[=========]	_	0s	328us/step	-	loss:	5.5990
Epoch	171/500						
	[=========]	-	0s	332us/step	-	loss:	5.5643
	172/500 [========]	_	Θe	225us/stan	_	1000:	5 51/12
	173/500		03	323u3/3cep	_	1033.	3.3143
	[======]	-	0s	329us/step	-	loss:	5.4618
	174/500			/ .		-	
	[=========] 175/500	-	0S	336us/step	-	loss:	5.4548
	[=========]	_	0s	324us/step	_	loss:	5.4074
Epoch	176/500						
	[=======]	-	0s	333us/step	-	loss:	5.3700
	177/500 [========]	_	Θe	322115/stan	_	1000:	5 2255
	178/500		03	322u3/31ep		1033.	3.3333
80/80	[=======]	-	0s	322us/step	-	loss:	5.3262
	179/500		0 -	000		1	F 0700
	[========] 180/500	-	0S	322us/step	-	1088:	5.2762
	[========]	_	0s	319us/step	-	loss:	5.2595
Epoch	181/500						
	[=========]	-	0s	329us/step	-	loss:	5.2129
	182/500 [========]	_	0.5	323us/sten	_	10881	5 1675
	183/500		00	020a3/3ccp		10001	011010
	[======]	-	0s	332us/step	-	loss:	5.1545
	184/500		0.0	26242/2422		10001	F 00F0
	[=========] 185/500	-	0S	362us/step	-	1088:	5.0959
	[=========]	-	0s	650us/step	-	loss:	5.0867
	186/500						
	[=========] 187/500	-	0s	332us/step	-	loss:	5.0699
	[=========]	_	0s	327us/step	_	loss:	5.0121
Epoch	188/500			·			
	[=======]	-	0s	342us/step	-	loss:	5.0059
	189/500 [========]	_	Ωc	33311c/cton	_	1000:	1 0188
	190/500		03	333u3/3cep	_	1033.	4.9400
80/80	[======]	-	0s	345us/step	-	loss:	4.9454
	191/500		0 =	04000/645		1.00	4 0070
	[========] 192/500	-	υS	34∠us/step	-	TOSS:	4.89/0
80/80	<u>[=====</u>	-	0s	328us/step	-	loss:	4.8521
x]/extensio	ns/Safe.js			•			

	193/500						
	[=====================================	-	0s	337us/step	-	loss:	4.8655
	[=========]	-	0s	347us/step	-	loss:	4.8146
	195/500						
	[=========] 196/500	-	0S	334us/step	-	loss:	4.7736
	[======================================	_	0s	326us/step	-	loss:	4.7604
Epoch	197/500						
	[======================================	-	0s	324us/step	-	loss:	4.7456
	198/500 [========]	_	0s	334us/step	_	loss:	4.7132
Epoch	199/500						
	[=======]	-	0s	325us/step	-	loss:	4.6981
	200/500 [===================================	_	0.5	331us/sten	_	1055'	4 6662
Epoch	201/500						
	[=======]	-	0s	326us/step	-	loss:	4.6417
	202/500 [==========]		0.0	222us/ston		10001	1 6266
	203/500	_	03	323u3/3tep	-	1033.	4.0200
80/80	[======]	-	0s	321us/step	-	loss:	4.5979
	204/500		0 -	000		1	4 0050
	[=====================================	-	ΘS	328us/step	-	TOSS:	4.6352
	[======================================	-	0s	321us/step	-	loss:	4.5774
	206/500						
	[=====================================	-	0s	317us/step	-	loss:	4.5514
	[======================================	-	0s	328us/step	-	loss:	4.5226
Epoch	208/500						
	[=====================================	-	0s	318us/step	-	loss:	4.5296
	[======================================	_	0s	318us/step	_	loss:	4.4774
Epoch	210/500						
	[========]	-	0s	308us/step	-	loss:	4.4678
	211/500 [=========]	_	0s	319us/sten	_	loss:	4.4531
Epoch	212/500						
	[=======]	-	0s	323us/step	-	loss:	4.4256
	213/500 [=========]	_	0.5	319us/sten	_	10881	4 4270
	214/500		03	010d3/3ccp		1033.	4.4270
	[======]	-	0s	316us/step	-	loss:	4.3969
	215/500 [=========]		0.0	220us/ston		10001	4 2700
	216/500	_	03	330us/step	-	1033.	4.3799
80/80	[======]	-	0s	322us/step	-	loss:	4.3553
	217/500 [========]		0.0	220112/2522		10001	4 2546
	218/500	-	08	339us/step	-	1055:	4.3546
	[======================================	-	0s	329us/step	-	loss:	4.3266
	219/500		•	000 - (-)		1	
	[=====================================	-	ΘS	306us/step	-	TOSS:	4.3234
	[=========]	-	0s	334us/step	_	loss:	4.3067
Epoch	221/500						
	[======================================	-	0s	324us/step	-	loss:	4.2928
	222/500 [========]	_	0s	321us/sten	_	loss:	4.2710
Epoch	223/500						
	[======================================	-	0s	319us/step	-	loss:	4.2558
_ <u>80/</u> 80	224/500 [=======]	_	0.5	311us/sten	_	loss:	4,2287
x]/extensio	ns/Safe.js		55	ao, ocop		_555.	,

Epoch	225/500						
	[======================================] -	0s	310us/step	-	loss:	4.2315
	226/500	,	•	010 - (-)			4 0070
	[=====================================] -	٥s	318us/step	-	TOSS:	4.2076
	[======================================	1 -	0s	316us/step	_	loss:	4.1853
	228/500	_		ошолого р			
	[======================================] -	0s	302us/step	-	loss:	4.1811
	229/500	_				_	
	[======================================] -	0s	314us/step	-	loss:	4.1893
	230/500 [===================================	1 _	00	32311s/sten	_	1000	1 1/186
	231/500	J	03	323u3/3tcp		1033.	4.1400
	[======================================] -	0s	335us/step	-	loss:	4.1365
	232/500						
	[======================================] -	0s	315us/step	-	loss:	4.1223
	233/500 [===================================	1 -	05	322us/sten	_	10881	4 1368
	234/500	7	00	0 22437300p		1000.	711000
	[======================================] -	0s	318us/step	-	loss:	4.1466
	235/500	_				-	
	226 (500] -	0s	307us/step	-	loss:	4.1068
	236/500 [===================================	1 -	0.5	330us/sten	_	10881	4 0966
	237/500	1	03	000и3/ 3сер		1033.	4.0300
	[======================================] -	0s	319us/step	-	loss:	4.0796
	238/500						
	[======================================] -	0s	314us/step	-	loss:	4.0695
	239/500 [===================================	1 -	05	322us/sten	_	10881	4 0514
	240/500	1	03	022 437 3 CCP		1033.	4.0014
	[======================================] -	0s	313us/step	-	loss:	4.0552
	241/500	_				_	
	242/502] -	0s	430us/step	-	loss:	4.0274
	242/500 [===================================	1 -	00	328us/sten	_	10881	4 0335
	243/500	1	03	020 03/300p		1033.	4.0000
	[======================================] -	0s	318us/step	-	loss:	4.0143
	244/500	_				_	
	245 (500] -	0s	327us/step	-	loss:	4.0086
	245/500 [===================================	1 -	0.5	332us/sten	_	loss:	4.0597
	246/500	1	•	002407 0000		10001	
80/80	[======================================] -	0s	328us/step	-	loss:	3.9825
	247/500	,				-	
	[=====================================] -	٥s	329us/step	-	TOSS:	3.9871
	[======================================	1 -	0s	331us/sten	_	loss:	3.9726
	249/500	_		ос-анти			
	[======================================] -	0s	332us/step	-	loss:	3.9738
	250/500	,	•	045 - / . /			0.0500
	[=====================================] -	٥s	315us/step	-	TOSS:	3.9596
	[======================================	1 -	0s	320us/step	_	loss:	3.9553
Epoch	252/500	_					
	[======================================] -	0s	329us/step	-	loss:	3.9258
	253/500		0.0	226		1	0.0750
	[=====================================] -	υS	3∠ous/step	-	TOSS:	3.9/56
	[======================================	1 -	0s	314us/step	_	loss:	3.9181
Epoch	255/500	_		•			
] -	0s	325us/step	-	loss:	3.9231
Epoch	256/500 <u>[=====</u> ===============================	1	0.0	21000/0+05		10001	2 9079
x]/extensio	ns/Safe.js] -	U S	эπons/sreb	-	T022!	3.09/8

	257/500						
	[=========] 258/500	-	0s	595us/step	-	loss:	3.9000
	[=====================================	_	0s	385us/step	_	loss:	3.8832
Epoch	259/500						
	[======================================	-	0s	320us/step	-	loss:	3.8819
	260/500 [===================================	_	05	316us/sten	_	1088:	3.8592
Epoch	261/500						
	[=======]	-	0s	329us/step	-	loss:	3.8558
	262/500 [========]		0.0	22/115/5100		10001	2 8600
	263/500	-	03	324u3/31ep	_	1055.	3.0000
	[======]	-	0s	332us/step	-	loss:	3.8659
	264/500 [===================================		0.0	226		1	0.0000
	265/500	-	08	326uS/Step	-	1055:	3.8369
	[=======]	-	0s	334us/step	-	loss:	3.8344
	266/500					-	
	[=====================================	-	0s	333us/step	-	loss:	3.8329
	[======================================	_	0s	328us/step	_	loss:	3.8542
Epoch	268/500			·			
	[======================================	-	0s	347us/step	-	loss:	3.8208
	269/500 [===================================	_	05	313us/sten	_	1088:	3.8149
Epoch	270/500			·			
	[=======]	-	0s	320us/step	-	loss:	3.8309
	271/500 [=======]		0.0	222115/5400		10001	2 9211
	272/500	_	05	332u5/5tep	-	1055.	3.0211
80/80	[=======]	-	0s	318us/step	-	loss:	3.8113
	273/500		•	000 - (-)		7	0.0054
	[=========] 274/500	-	ΘS	320us/step	-	TOSS:	3.8051
	[======================================	_	0s	333us/step	_	loss:	3.7773
	275/500					_	_
	[=====================================	-	0s	333us/step	-	loss:	3.7714
	[======================================	_	0s	320us/step	_	loss:	3.7759
Epoch	277/500						
	[======================================	-	0s	317us/step	-	loss:	3.7793
	278/500 [========]	_	05	334us/sten	_	1088:	3.7626
Epoch	279/500			·			
	[======]	-	0s	332us/step	-	loss:	3.7666
	280/500 [===================================	_	Θs	318us/sten	_	lossi	3 7660
	281/500		03	010и3/31ср		1033.	3.7003
	[======]	-	0s	321us/step	-	loss:	3.7440
	282/500 [=========]		0.0	220110/0100		10001	2 7492
	283/500	-	08	320us/step	-	1055:	3.7483
	[=======]	-	0s	333us/step	-	loss:	3.7658
	284/500					-	
	[=====================================	-	0s	320us/step	-	loss:	3.7313
	[======================================	_	0s	319us/step	_	loss:	3.7238
	286/500						
	[=====================================	-	0s	331us/step	-	loss:	3.7513
	[======================================	_	0s	321us/sten	_	loss:	3.7112
Epoch	288/500			·			
80/80 x]/extensio	[========] ns/Safe.is	-	0s	317us/step	-	loss:	3.7225
.,	,-						

	289/500					_	
	[=====================================	-	0s	312us/step	-	loss:	3.7409
	[=========]	-	0s	317us/step	-	loss:	3.7065
	291/500						
	[=====================================	-	0s	321us/step	-	loss:	3.7286
	[=========]	_	0s	321us/step	_	loss:	3.6889
Epoch	293/500			·			
		-	0s	316us/step	-	loss:	3.7074
	294/500 [===================================	_	0.5	313us/sten	_	10881	3 6974
Epoch	295/500			·			
	[=======]	-	0s	304us/step	-	loss:	3.7051
	296/500 [===================================		0.0	215us/ston		10001	2 7002
	297/500	_	03	313u3/31ep	_	1055.	3.7093
80/80	[======]	-	0s	316us/step	-	loss:	3.6809
	298/500		•	014 - (-1		7	0 0004
	[=====================================	-	ΘS	314us/step	-	TOSS:	3.6894
	[======================================	-	0s	320us/step	_	loss:	3.6984
	300/500			·			
	[======================================	-	0s	306us/step	-	loss:	3.6973
	301/500 [========]	_	0s	308us/step	_	loss:	3.7049
Epoch	302/500			·			
	[=======]	-	0s	311us/step	-	loss:	3.6739
	303/500 [==========]	_	0 c	318us/sten	_	10881	3 6570
	304/500		03	510u3/3cep	_	1033.	3.0379
80/80	[=======]	-	0s	312us/step	-	loss:	3.6560
	305/500 [========]		0.0	220112 (2122		10001	0 6717
	306/500	-	08	320us/step	-	1055:	3.0/1/
	[========]	-	0s	323us/step	-	loss:	3.6724
	307/500					-	
	[=========] 308/500	-	ΘS	319us/step	-	TOSS:	3.6826
	[======================================	_	0s	315us/step	_	loss:	3.6616
Epoch	309/500			·			
	[========] 310/500	-	0s	315us/step	-	loss:	3.6727
	[=========]	_	0s	315us/step	_	loss:	3.6488
Epoch	311/500			·			
	[========]	-	0s	416us/step	-	loss:	3.6353
	312/500 [===================================	_	05	329us/sten	_	10881	3 6233
	313/500		03	02 0037 3 CCP		1033.	0.0200
	[======]	-	0s	319us/step	-	loss:	3.6433
	314/500 [===================================		0.0	21 440 / 0 + 0 0		10001	2 6200
	315/500	-	08	314uS/Step	-	1055:	3.0208
	[=======]	-	0s	316us/step	-	loss:	3.6283
	316/500					-	
	[=========] 317/500	-	0s	322us/step	-	loss:	3.6195
	[======================================	-	0s	326us/step	_	loss:	3.6235
Epoch	318/500			·			
	[=========] 319/500	-	0s	310us/step	-	loss:	3.6097
	319/500 [=========]	_	0s	323us/sten	_	loss:	3.6137
Epoch	320/500			·			
80/80 x]/extensio	[=======] ns/Safe.is	-	0s	321us/step	-	loss:	3.6157
.,	0.,0						

	321/500					_	
	[========] 322/500	-	0s	326us/step	-	loss:	3.6435
80/80	[======]	-	0s	322us/step	-	loss:	3.6306
	323/500 [=======]		0.0	222110/0400		10001	2 6145
	324/500	-	08	322uS/Step	-	1055:	3.0145
80/80	[======]	-	0s	310us/step	-	loss:	3.6014
	325/500		0 -	010/		1	0 5005
	[========] 326/500	-	ΘS	312us/step	-	TOSS:	3.5965
	[======================================	-	0s	315us/step	-	loss:	3.5899
	327/500					-	
	[========] 328/500	-	0S	31/us/step	-	loss:	3.6027
	[======================================	_	0s	325us/step	_	loss:	3.5906
Epoch	329/500						
	[========] 330/500	-	0s	325us/step	-	loss:	3.5874
	[=========]	_	0s	415us/step	_	loss:	3.6069
Epoch	331/500			·			
	[======================================	-	0s	502us/step	-	loss:	3.6074
	332/500 [========]	_	0s	315us/sten	_	loss:	3.6006
Epoch	333/500						
	[=======]	-	0s	316us/step	-	loss:	3.5961
	334/500 [========]	_	Θs	33711s/sten	_	10881	3 5883
Epoch	335/500						
	[======]	-	0s	317us/step	-	loss:	3.6020
	336/500 [=========]		0.0	225uc/ctop		10001	2 5606
	337/500	-	05	325uS/Step	-	1055.	3.5000
80/80	[======]	-	0s	331us/step	-	loss:	3.5752
	338/500		0 -	000		1	0 5000
	[========] 339/500	-	0S	320us/step	-	1088:	3.5686
	[=======]	-	0s	442us/step	-	loss:	3.5853
	340/500		0 -	000 / - +		1	0 5000
	[========] 341/500	-	ΘS	336us/step	-	TOSS:	3.5620
	[=======]	-	0s	328us/step	-	loss:	3.5645
	342/500						
	[=======] 343/500	-	0S	342us/step	-	IOSS:	3.5627
	[======================================	-	0s	364us/step	-	loss:	3.5679
	344/500					_	
	[========] 345/500	-	0s	377us/step	-	loss:	3.5686
	[=========]	_	0s	369us/step	_	loss:	3.5569
Epoch	346/500			·			
	[========] 347/500	-	0s	391us/step	-	loss:	3.5579
	[==========]	_	0s	397us/step	_	loss:	3.5554
Epoch	348/500						
	[======================================	-	0s	542us/step	-	loss:	3.5766
	349/500 [========]	_	0s	395us/step	_	loss:	3.5780
Epoch	350/500			·			
	[======================================	-	0s	341us/step	-	loss:	3.5681
	351/500 [========]	_	0.5	350us/sten	_	loss:	3,5530
Epoch	352/500			·			
80/80 x]/extension	[======] ns/Safe is	-	0s	337us/step	-	loss:	3.5665
MI CALCITOIDI	10,040,019						

Fnoch	353/500						
	[========]	_	0s	325us/step	_	loss:	3.5346
	354/500						
	[======]	-	0s	338us/step	-	loss:	3.5548
	355/500			/ .		-	
	[=========]	-	0s	336us/step	-	loss:	3.5507
	356/500 [===================================		0.0	226us/ston		1000:	2 52/7
	357/500	-	05	330u5/5tep	-	1055.	3.3347
	[========]	_	0s	340us/step	_	loss:	3.5601
	358/500			·			
	[======]	-	0s	327us/step	-	loss:	3.5560
	359/500		•	005 - /		1	
	[========] 360/500	-	ΘS	335us/step	-	TOSS:	3.53/5
	[======================================	_	05	364us/sten	_	loss:	3.5265
	361/500		•	30 1437 323p		1000.	0.0200
80/80	[======]	-	0s	329us/step	-	loss:	3.5497
	362/500						
	[========]	-	0s	343us/step	-	loss:	3.5213
	363/500 [===================================		0.0	226us/ston		1000:	2 5210
	364/500	-	05	320uS/Step	-	1055.	3.5210
	[======================================	_	0s	335us/step	_	loss:	3.5369
Epoch	365/500						
	[======]	-	0s	331us/step	-	loss:	3.5133
	366/500					-	
	[======================================	-	0s	332us/step	-	loss:	3.5344
	367/500 [===================================	_	0.5	313us/sten	_	10881	3 5358
	368/500		03	010и3/ 3сер		1033.	0.0000
	[========]	-	0s	308us/step	-	loss:	3.5130
Epoch	369/500						
	[======]	-	0s	326us/step	-	loss:	3.5481
	370/500 [========]		0.0	22742/2422		10001	0 5000
	371/500	-	05	32/us/step	-	1055.	3.5333
	[=========]	_	0s	318us/step	_	loss:	3.5075
Epoch	372/500						
	[======]	-	0s	324us/step	-	loss:	3.5189
	373/500		•	007 - /		1	
	[=========] 374/500	-	٥s	32/us/step	-	TOSS:	3.5285
	[======================================	_	0.5	329us/sten	_	10881	3 5239
	375/500		00	020a3/3ccp		10001	0.0200
80/80	[=======]	-	0s	322us/step	-	loss:	3.5185
	376/500						
	[=========]	-	0s	317us/step	-	loss:	3.4991
	377/500 [========]	_	٩c	21711c/cton	_	1000	2 5017
	378/500	-	03	31/us/step	_	1055.	3.3017
	[========]	_	0s	323us/step	_	loss:	3.5043
Epoch	379/500			·			
	[======]	-	0s	306us/step	-	loss:	3.5182
	380/500		0 -	001/		1	0 5405
	[========] 381/500	-	υS	331us/step	-	1088:	3.5195
	[=========]	_	0s	327us/step	_	loss:	3.5129
	382/500			о			
	[======]	-	0s	332us/step	-	loss:	3.4868
	383/500		_	045 ()		1.	0 -0
	[======================================	-	٥s	315us/step	-	TOSS:	3.5368
	384/500 [===================================	_	0 <	320us/sten	_	1055'	3.5096
x]/extensio	ns/Safe.js		J J	э_сас, эсср		10001	3.0000

	385/500		0 -	000 - (-1		7	0 5004
	[========] 386/500	-	ΘS	322us/step	-	IOSS:	3.5281
80/80	[=======]	-	0s	407us/step	-	loss:	3.5034
	387/500 [=======]	_	0s	340us/step	_	loss:	3.4909
Epoch	388/500			·			
	[========] 389/500	-	0s	315us/step	-	loss:	3.5108
	[======================================	-	0s	324us/step	-	loss:	3.4815
	390/500 [=======]		0.0	217uc/cton		10001	2 4946
Epoch	391/500			·			
	[=========]	-	0s	337us/step	-	loss:	3.5112
	392/500 [===================================	_	0s	318us/step	_	loss:	3.4864
Epoch	393/500						
	[=========] 394/500	-	0s	340us/step	-	loss:	3.4974
	[=========]	-	0s	315us/step	-	loss:	3.4965
	395/500		0.0	220112/2122		10001	2 4012
	[========] 396/500	-	υS	320us/step	-	1088:	3.4812
80/80	[======]	-	0s	315us/step	-	loss:	3.4771
	397/500 [===================================	_	0.5	311us/sten	_	lnssi	3 5079
Epoch	398/500						
	[======================================	-	0s	320us/step	-	loss:	3.4940
	399/500 [========]	_	0s	328us/step	_	loss:	3.4715
Epoch	400/500			·			
	[=====================================	-	0s	343us/step	-	loss:	3.5037
80/80	[======]	-	0s	571us/step	-	loss:	3.4955
	402/500 [===================================		0.0	21 Fuc/ston		10001	2 4050
Epoch	403/500						
	[=======]	-	0s	324us/step	-	loss:	3.4848
	404/500 [===================================	_	0s	323us/step	_	loss:	3.4814
Epoch	405/500						
	[=====================================	-	0s	322us/step	-	loss:	3.4910
80/80	[======]	-	0s	307us/step	-	loss:	3.4825
	407/500 [========]		0.0	22Euc/ston		10001	2 4700
	408/500	-	05	323u3/31ep	-	1055.	3.4700
	[========]	-	0 s	333us/step	-	loss:	3.4858
	409/500 [============]	_	0s	329us/step	_	loss:	3.4801
Epoch	410/500			·			
	[=====================================	-	0s	315us/step	-	loss:	3.4641
	[======================================	-	0s	322us/step	-	loss:	3.4720
	412/500		0.5	22000 / 2 + 2 2		1	0 4054
	[=====================================	-	υS	336uS/Step	-	1088:	3.4854
80/80	[======]	-	0s	333us/step	-	loss:	3.4822
	414/500 [===================================	_	0.5	334us/sten	_	loss:	3.4851
Epoch	415/500			·			
	[=====================================	-	0s	329us/step	-	loss:	3.4773
80/80	<u>[=====</u>	-	0s	317us/step	-	loss:	3.4912
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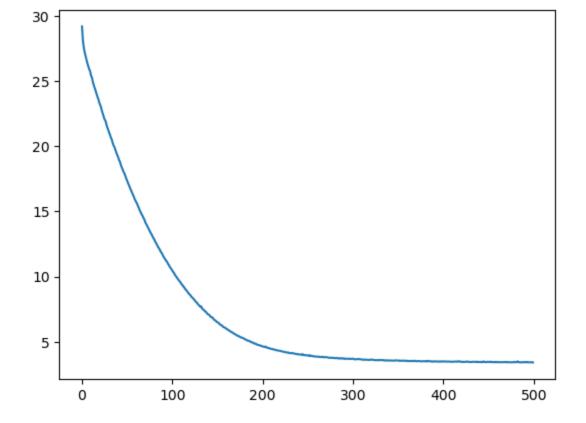
	417/500				_	
	[=========] 418/500	-	0s	316us/step -	loss:	3.4699
80/80	[======]	-	0s	318us/step -	loss:	3.5069
	419/500 [=========]	_	0.5	313us/sten -	10001	3 5000
	420/500	-	03	313u3/3tep -	1055.	3.3000
	[======================================	-	0s	331us/step -	loss:	3.4631
	421/500 [========]	_	0s	319us/step -	loss:	3.4680
Epoch	422/500			•		
	[=========] 423/500	-	0s	310us/step -	loss:	3.4692
80/80	[======]	-	0s	306us/step -	loss:	3.4539
	424/500 [=========]	_	05	321us/sten -	10881	3 4606
Epoch	425/500					
	[========] 426/500	-	0s	314us/step -	loss:	3.4699
	[==========]	-	0s	315us/step -	loss:	3.4677
	427/500		0.0	220 /atan	1	0 4000
	[=========] 428/500	-	0S	320us/step -	1088:	3.4899
80/80	[======]	-	0s	312us/step -	loss:	3.4806
	429/500 [========]	_	0s	313us/step -	loss:	3.4466
Epoch	430/500					
	[========] 431/500	-	0s	320us/step -	loss:	3.4573
	[==========]	-	0s	307us/step -	loss:	3.4512
	432/500 [========]		0.0	20Euc/cton	10001	2 4400
Epoch	433/500					
	[======]	-	0s	313us/step -	loss:	3.4659
	434/500 [========]	_	0s	326us/step -	loss:	3,4612
Epoch	435/500			•		
	[========] 436/500	-	0s	311us/step -	loss:	3.4721
80/80	[======]	-	0s	319us/step -	loss:	3.4625
	437/500 [========]	_	05	317us/sten -	1055:	3.4482
Epoch	438/500			•		
	[========] 439/500	-	0s	305us/step -	loss:	3.4826
	[========]	-	0s	309us/step -	loss:	3.4523
	440/500		0.0	21000/0100	10001	2 4540
	[========] 441/500	-	US	318us/step -	1055:	3.4549
	[======]	-	0s	307us/step -	loss:	3.4475
	442/500 [========]	_	0s	317us/step -	loss:	3.4615
Epoch	443/500					
	[========] 444/500	-	0s	307us/step -	loss:	3.4382
80/80	[======]	-	0s	322us/step -	loss:	3.4451
	445/500 [========]	_	0.5	308us/sten -	10551	3 4979
Epoch	446/500					
	[=====================================	-	0s	310us/step -	loss:	3.4532
	4477500 [========]	-	0s	332us/step -	loss:	3.4581
Epoch	448/500		0 -	21740/05	1000	0 4004
<u>80780</u> k]/extensio	「=======] ns/Safe.js	-	٥S	si/us/step -	TOSS:	3.4334

·	449/500									
	[=====================================		======	:=====]	-	0s	316us/step	-	loss:	3.4492
80/80	[=====	======	======	:=====]	-	0s	323us/step	-	loss:	3.4717
	451/500			1	l _	0.0	297us/step		locci	3 4476
Epoch	452/500									
			======	:=====]	-	0s	318us/step	-	loss:	3.4557
	453/500 [=====		======	:=====]	-	0s	323us/step	_	loss:	3.4799
	454/500			_		0 -	010 . (.)		1	0 4000
	455/500		======	=====]	-	٥s	319us/step	-	IOSS:	3.4396
	_	======	======	:=====]	-	0s	316us/step	-	loss:	3.4488
•	456/500 [=====		======	:=====1	l -	0s	305us/step	_	loss:	3.4428
Epoch	457/500									
	458/500	======	======	:=====]	-	0s	314us/step	-	loss:	3.4527
80/80	[=====		======	======]	-	0s	327us/step	-	loss:	3.4265
·	459/500 Γ=====	=======	=======	:=====1	l -	0s	327us/step	_	loss:	3.4667
Epoch	460/500									
	[======= 461/500		======	:=====]	-	0s	310us/step	-	loss:	3.4392
			======	======]	-	0s	333us/step	-	loss:	3.4508
	462/500				1	0.0	220 /atam		1	0 4010
	463/500				-	ΰS	320us/step	-	1088:	3.4316
			======	:=====]	-	0s	331us/step	-	loss:	3.4355
	464/500 [=====		======	:======1	l -	0s	332us/step	_	loss:	3.4474
Epoch	465/500									
	466/500		======	:=====]	-	0s	328us/step	-	loss:	3.4316
80/80	[=====	======	======	:=====]	-	0s	334us/step	-	loss:	3.4356
	467/500			-=====1	l _	0.5	318us/step	_	lossi	3 4319
Epoch	468/500									
	[======= 469/500		======	:=====]	-	0s	327us/step	-	loss:	3.4495
			======	======]	-	0s	328us/step	-	loss:	3.4392
•	470/500				1	0.0	204/24.22		1	0 4504
	471/500				-	ΰS	304us/step	-	1088:	3.4521
		======	======	:=====]	-	0s	318us/step	-	loss:	3.4234
•	472/500 [=====		======	:======1	l -	0s	312us/step	_	loss:	3.4453
Epoch	473/500									
	[=====================================	======	======	:=====]	-	0s	321us/step	-	loss:	3.4391
80/80	[=====	======	======	======]	-	0s	324us/step	-	loss:	3.4318
·	475/500			1	l _	0.5	584us/step	_	lossi	3 /357
Epoch	476/500									
		======	======	:=====]	-	0s	338us/step	-	loss:	3.4336
	477/500 [=====	======	======	:=====]	-	0s	337us/step	-	loss:	3.4244
Epoch	478/500									
	479/500	=======	======	======]	-	⊎S	319us/step	-	TOSS:	3.4334
80/80	[=====		======	:=====]	-	0s	326us/step	-	loss:	3.4623
	480/500 Γ=====		======	:======7	l -	0s	329us/step	_	loss:	3,4365
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```
Epoch 481/500
80/80 [============== ] - 0s 329us/step - loss: 3.4444
Epoch 482/500
80/80 [============== ] - 0s 320us/step - loss: 3.4348
Epoch 483/500
80/80 [=============== ] - 0s 316us/step - loss: 3.5030
Epoch 484/500
80/80 [============== ] - 0s 344us/step - loss: 3.4520
Epoch 485/500
80/80 [============== ] - 0s 309us/step - loss: 3.4257
Epoch 486/500
80/80 [============== ] - 0s 319us/step - loss: 3.4347
Epoch 487/500
80/80 [============= ] - 0s 326us/step - loss: 3.4228
Epoch 488/500
80/80 [============== ] - 0s 323us/step - loss: 3.4372
Epoch 489/500
80/80 [=============== ] - 0s 318us/step - loss: 3.4280
Epoch 490/500
80/80 [============== ] - 0s 327us/step - loss: 3.4513
Epoch 491/500
80/80 [============= ] - 0s 312us/step - loss: 3.4384
Epoch 492/500
80/80 [============= ] - 0s 320us/step - loss: 3.4441
Epoch 493/500
80/80 [============= ] - 0s 318us/step - loss: 3.4202
Epoch 494/500
80/80 [============== ] - 0s 332us/step - loss: 3.4579
Epoch 495/500
80/80 [=============== ] - 0s 308us/step - loss: 3.4340
Epoch 496/500
80/80 [============== ] - 0s 318us/step - loss: 3.4309
Epoch 497/500
80/80 [============== ] - 0s 310us/step - loss: 3.4244
Epoch 498/500
80/80 [============= ] - 0s 318us/step - loss: 3.4343
Epoch 499/500
80/80 [============== ] - 0s 313us/step - loss: 3.4414
Epoch 500/500
80/80 [============= ] - 0s 313us/step - loss: 3.4154
```

Use the training history to plot how the loss function changed over each training epoch.

```
In [30]: # put your answer here
plt.plot(history.history['loss'])
Out[30]: [<matplotlib.lines.Line2D at 0x2879f4d00>]
```



put your answer here

What equation does the model provide for predicting open rate?

```
In [31]:
         model.get_weights()
         [array([[0.6849418],
Out[31]:
                  [5.620405]], dtype=float32),
          array([5.9561067], dtype=float32)]
In [32]:
         w0 = model.get_weights()[1]
         w1 = model.get_weights()[0][0]
         w2 = model.get_weights()[0][1]
         print(" equation: open_rate = %.2f + %.2f * savings_pct + %.2f * coupon_or_discount"%(w0)
In [33]:
          equation: open_rate = 5.96 + 0.68 * savings_pct + 5.62 * coupon_or_discount
         y_pred = w0 + np.dot(x, [w1, w2])
In [34]:
In [35]:
         np.mean((y-y_pred)**2)
         3.399910798139473
Out[35]:
```