1.) List the five most common trigrams:
   a. Listing seven, as we have a few ties, here are our top five common trigrams:

```
Trigram Analysis:
1: ziz 10
2: goy 7
3: nkx 6
4: tnf 6
5: whk 5
6: dqg 5
7: big 4
```

2.) Show the difference between the starting indexes of the five most common trigrams:
   a. Same as before, listing seven – here are the occurrences:

```
>> Appearances for:  ziz
// First Occurance:  367
// Spaces till Next Occurance 482
// Spaces till Next Occurance 80
// Spaces till Next Occurance 13
// Spaces till Next Occurance 187
// Spaces till Next Occurance 120
// Spaces till Next Occurance 130
// Spaces till Next Occurance 45
// Spaces till Next Occurance 45
// Spaces till Next Occurance 55

>> Appearances for:  goy
// First Occurance:  77
// Spaces till Next Occurance 510
// Spaces till Next Occurance 27
// Spaces till Next Occurance 515
// Spaces till Next Occurance 95
// Spaces till Next Occurance 30
// Spaces till Next Occurance 85

>> Appearances for:  nkx
// First Occurance:  16
// Spaces till Next Occurance 36
// Spaces till Next Occurance 25
// Spaces till Next Occurance 265
// Spaces till Next Occurance 910
// Spaces till Next Occurance 30

>> Appearances for:  tnf
// First Occurance:  426
// Spaces till Next Occurance 591
// Spaces till Next Occurance 355
// Spaces till Next Occurance 45
// Spaces till Next Occurance 70
// Spaces till Next Occurance 20

>> Appearances for:  whk
// First Occurance:  80
// Spaces till Next Occurance 200
// Spaces till Next Occurance 55
// Spaces till Next Occurance 400
// Spaces till Next Occurance 195
```

```
>> Appearances for:  dqg
// First Occurance:  364
// Spaces till Next Occurance 559
// Spaces till Next Occurance 65
// Spaces till Next Occurance 600
// Spaces till Next Occurance 25

>> Appearances for:  big
// First Occurance:  58
// Spaces till Next Occurance 93
// Spaces till Next Occurance 65
// Spaces till Next Occurance 340
```

3.) Based on our findings, what do you suspect the key length is?
   a. Based on what we could see from the differences from the indexes of the occurrence, I suspect the key length to be 5, either a word or some random characters.
   b. Specifically, if we look at some of the occurrences, while we progress through the occurrences, we begin to see multiples of 5 as seen above.

4.) Separate the ciphertext into X shift-by-N ciphers where X is the length of the key and perform monoalphabetic frequency analysis on each. What are the three most common ciphertext characters in each of the shift-by-N ciphers?
   a. For starters, when running my Python code – I allowed the user to pick which character 'i', they would like to shift (with 1 being the first character in the potential X, and X being the maximum character in that sequence a user can shift). This can be tested after the completion of the frequency analysis in the program.
   b. As seen here, we selected a key that is of length 5, here is our individual frequency analysis for each shift-by-N cipher (next page):

```
==========================================================================================
>> What is your Key Length?
5
>> How many characters in the singular frequency analysis would you like to display?
3
==========================================================================================
>> Here is your mono-aphabetic frequency analysis for the 1th character
#1: h 2.7%
#2: w 1.9%
#3: r 1.9%
==========================================================================================
>> Here is your mono-aphabetic frequency analysis for the 2th character
#1: e 3.0%
#2: o 2.3%
#3: a 1.7%
==========================================================================================
>> Here is your mono-aphabetic frequency analysis for the 3th character
#1: k 2.7%
#2: z 2.5%
#3: u 1.9%
==========================================================================================
>> Here is your mono-aphabetic frequency analysis for the 4th character
#1: f 2.5%
#2: u 1.9%
#3: o 1.7%
==========================================================================================
>> Here is your mono-aphabetic frequency analysis for the 5th character
#1: z 3.1%
#2: d 1.9%
#3: j 1.8%
==========================================================================================
```

5.) Iterations until Key is found:

1st Attempt, we shifted every character by E.

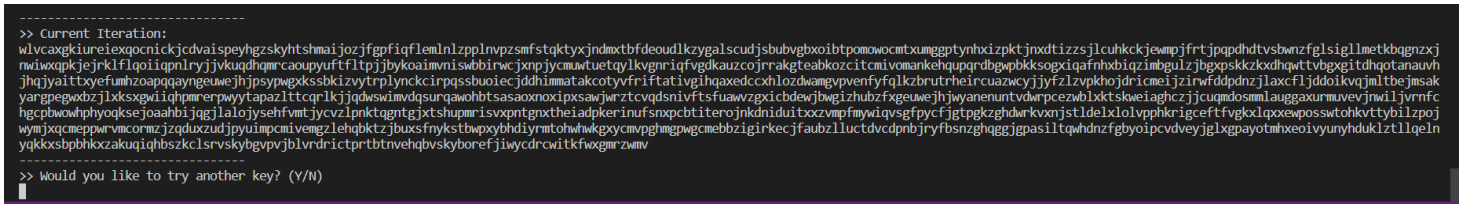
```
>> Current Iteration:
wlvcaxgkiureiexqocnickjcdvaispeyhgzskyhtshmaijozjfgpfiqflemlnlzpplnvpzsmfstqktyxjndmxtbfdeoudlkzygalscudjsbubvgbxoibtpomowocmtxumggptynhxizpktjnxdtizzsjlcuhkckjewmpjfrtjpqpdhdtvsbwnzfglsigllmetkbqgnzxj
nwiwxqpkjejrklflqoiiqpnlryjjvkuqdhqmrcaoupyuftfltpjjbykoaimvniswbbirwcjxnpjycmuwtuetqylkvgnriqfvgdkauzcojrrakgteabkozcitcmivomankehqupqrdbgwpbkksogxiqafnhxbiqzimbgulzjbgxpskkzkxdhqwttvbgxgitdhqotanauvh
jhqjyaittxyefumhzoapqqayngeuwejhjpsypwgxkssbkizvytrplynckcirpqssbuoiecjddhimmatakcotyvfriftativgihqaxedccxhlozdwamgvpvenfyfqlkzbrutrheircuazwcyjjyfzlzvpkhojdricmeijzirwfddpdnzjlaxcfljddoikvqjmltbejmsak
yargpegwxbzjlxksxgwiiqhpmrerpwyytapazlttcqrlkjjqdwswimvdqsurqawohbtsasaoxnoxipxsawjwrztcvqdsnivftsfuawvzgxicbdewjbwgizhubzfxgeuwejhjwyanenuntvdwrpcezwblxktskweiaghczjjcuqmdosmmlauggaxurmuvevjnwiljvrnfc
hgcpbwowhphyoqksejoaahbijqgjlalojysehfvmtjycvzlpnktqgntgjxtshupmrisvxpntgnxtheiadpkerinufsnxpcbtiterojnkdniduitxxzvmpfmywiqvsgfpycfjgtpgkzghdwrkvxnjstldelxlolvpphkrigceftfvgkxlqxxewposswtohkvttybilzpoj
wymjxqcmeppwrvmcormzjzqduxzudjpyuimpcmivemgzlehqbktzjbuxsfnykstbwpxybhdiyrmtohwhwkgxycmvpghmgpwgcmebbzigirkecjfaubzlluctdvcdpnbjryfbsnzghqggjgpasiltqwhdnzfgbyoipcvdveyjglxgpayotmhxeoivyunyhduklztllqeln
yqkkxsbpbhkxzakuqiqhbszkclsrvskybgvpvjblvrdrictprtbtnvehqbvskyborefjiwycdrcwitkfwxgmrzwmv
--------------------------------
>> Would you like to try another key? (Y/N)
```

2nd – 6th Attempt, since we do not know if the key is a word or a set of characters – we go with a safe route and since we know that the most common starting letters for the alphabet are t,a,o,d,w – we try all of them. We come to find that this doesn't really clarify much:

```
>> What do you suspect your key to be? (must be same length as key)
aeeee

--------------------------------
>> Current Iteration:
wlvcaxgkiureiexqocnickjcdvaispeyhgzskyhtshmaijozjfgpfiqflemlnlzpplnvpzsmfstqktyxjndmxtbfdeoudlkzygalscudjsbubvgbxoibtpomowocmtxumggptynhxizpktjnxdtizzsjlcuhkckjewmpjfrtjpqpdhdtvsbwnzfglsigllmetkbqgnzxj
nwiwxqpkjejrklflqoiiqpnlryjjvkuqdhqmrcaoupyuftfltpjjbykoaimvniswbbirwcjxnpjycmuwtuetqylkvgnriqfvgdkauzcojrrakgteabkozcitcmivomankehqupqrdbgwpbkksogxiqafnhxbiqzimbgulzjbgxpskkzkxdhqwttvbgxgitdhqotanauvh
jhqjyaittxyefumhzoapqqayngeuwejhjpsypwgxkssbkizvytrplynckcirpqssbuoiecjddhimmatakcotyvfriftativgihqaxedccxhlozdwamgvpvenfyfqlkzbrutrheircuazwcyjjyfzlzvpkhojdricmeijzirwfddpdnzjlaxcfljddoikvqjmltbejmsak
yargpegwxbzjlxksxgwiiqhpmrerpwyytapazlttcqrlkjjqdwswimvdqsurqawohbtsasaoxnoxipxsawjwrztcvqdsnivftsfuawvzgxicbdewjbwgizhubzfxgeuwejhjwyanenuntvdwrpcezwblxktskweiaghczjjcuqmdosmmlauggaxurmuvevjnwiljvrnfc
hgcpbwowhphyoqksejoaahbijqgjlalojysehfvmtjycvzlpnktqgntgjxtshupmrisvxpntgnxtheiadpkerinufsnxpcbtiterojnkdniduitxxzvmpfmywiqvsgfpycfjgtpgkzghdwrkvxnjstldelxlolvpphkrigceftfvgkxlqxxewposswtohkvttybilzpoj
wymjxqcmeppwrvmcormzjzqduxzudjpyuimpcmivemgzlehqbktzjbuxsfnykstbwpxybhdiyrmtohwhwkgxycmvpghmgpwgcmebbzigirkecjfaubzlluctdvcdpnbjryfbsnzghqggjgpasiltqwhdnzfgbyoipcvdveyjglxgpayotmhxeoivyunyhduklztllqeln
yqkkxsbpbhkxzakuqiqhbszkclsrvskybgvpvjblvrdrictprtbtnvehqbvskyborefjiwycdrcwitkfwxgmrzwmv
--------------------------------
>> Would you like to try another key? (Y/N)
```

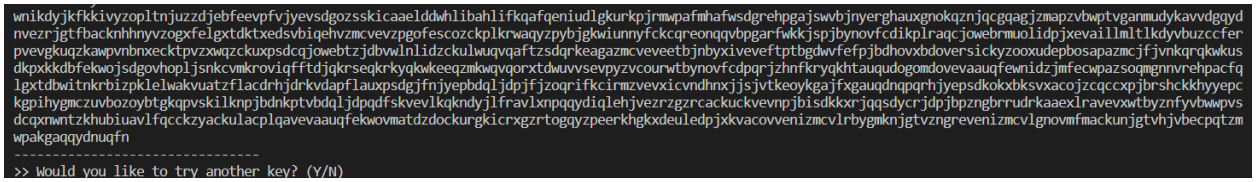
7th – 14th attempt: with not much discernible words, we attempt (in order) the most frequent letters for the second frequency paired with our previously stated set of five letters that we started with for the first character (keep in mind, the rest of the letter sequence is still shifted by e).



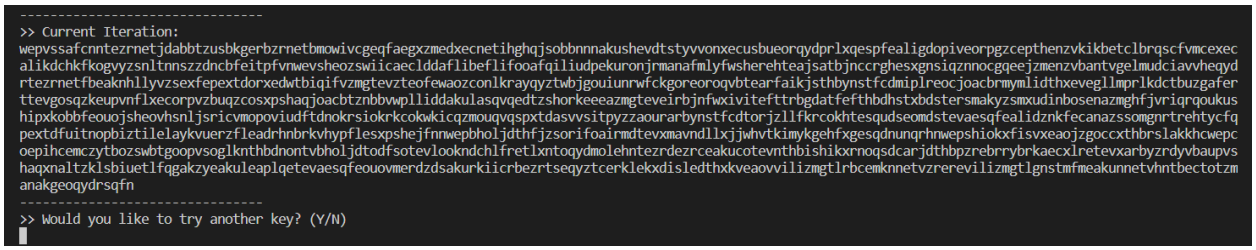
As seen above, we have yet to find a key – now with a string of characters to choose from for both the first and second characters – we begin to pick the potential 3rd character by working our way down the list of appearances. Ideally, we luck out here – as this has essentially become a brute forcing of this cipher.

15th – 23rd attempt.

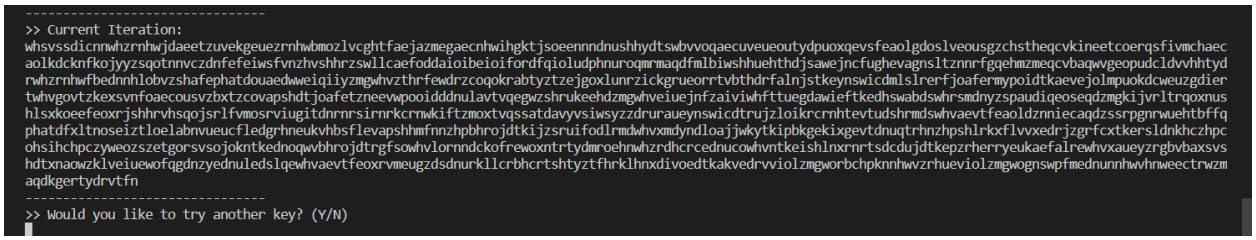
At this point, I realized, that I my math was a bit off in my tool. See, rather than subtracting the shift amount – and cycling through – I was adding it. Resulting in a never jumble of letters. I tried the experiment all over again. Beginning with everything shifted by E.



Using the same strategy we employed earlier, we then move onto a combination for the first and second character in the sequence that potentially works.



Using our intuition (this is probably around attempt 10 in the new go), we see a few words that could be formed by shifting the third character by 2.



Following the same strategy, we move onto the fourth characters in this cipher:

```
>> Current Iteration:
wesessailnnthirnewsdabeczusetgereirnewkmowlecgetoaegaimedancnewrhghtssobewnnandsheymtstbevonancusedeorthdprogqessoeallpdopleeorspzceschencekikentcleaqsciemceanc
alltdchnokogyhzsnocnnscidnceoeitsovnwhesheriswillaecomdaforbeforfoodoqilldd pendronmamandomlyifsheunhtedssatesnccuphesapnsitinnofpqeemimencebanwegelpddcidevhethd
rthirnewobeanwhllbezseaoepeacdorandwterqifyimgthezteroewariconotraythztwesgouldnrwilkgounorotebtedafainssthehnstildmisureofsoaceamymordthanvegoumprotdctedzgainr
tthegostikeusenflancorsezbuticosayshatsoaceczn beewplorddandlasteqedwishouteeedimgtheeiresnfwarvithottrepdatinfthemhstakdsthasmanhzsmaddinexsendimghisvritaqounds
hisgkobeoeourssherehsnossrifemopreiudicdnonasionakconfkictimouteqspacdasyesitshzzardrarehnstildtouszllitrconqtestddservdstheaestoeallmznkincandissoppnrtunhtyfoq
peacdfulcnoperztionlayneuercoleagahnbutvhysolesayshemonnwhybhoosdthiszsourfoalamdthexmaywdllasjwhyckimbtgehiggestmnuntahnwhyshirtxfivexearszgoflxtheaslanthcwhyc
oesrhceplzytexzswecgoosesogotnthemnonwebhoosdtogosotheloonwdchooretogntothdmoonhnthirdecaceandcothenthershingrnotbdcausdtheyzreearybutaecaurethexarehzrdbebauses
hatgnalwiklseruetooqganiyeandleasuqetheaestoeouremergidsandrkillrbecatsethztchaklengdisondthatvearevillimgtoabceptnnewezreunvillimgtopnstpomeandnnewehntenctowim
andtgeothdrston
--------------------------------
>> Would you like to try another key? (Y/N)
```

And finally, we move onto the final character:

```
--------------------------------
>> Current Iteration:
wesetsailonthisnewseabecausethereisnewknowledgetobegainedandnewrightstobewonandtheymustbewonandusedfortheprogressofallpeopleforspacesciencelikenuclearscienceand
alltechnologyhasnoconscienceofitsownwhetheritwillbecomeaforceforgoodorilldependsonmanandonlyiftheunitedstatesoccupiesapositionofpreeminencecanwehelpdecidewhethe
rthisnewoceanwillbeaseaofpeaceoranewterrifyingtheaterofwaridonotsaythatweshouldorwillgounprotectedagainstthehostilemisuseofspaceanymorethanwegounprotectedagains
tthehostileuseoflandorseabutidosaythatspacecanbeexploredandmasteredwithoutfeedingthefiresofwarwithoutrepeatingthemistakesthatmanhasmadeinextendinghiswritaroundt
hisglobeofourstherеisnostrifenoprejudicenonationalconflictinouterspaceasyetitshazardsarehostiletousallitsconquestdeservesthebestofallmankindanditsopportunityfor
peacefulcooperationmaynevercomeagainbutwhysomesaythemoonwhychoosethisasourgoalandtheymaywellaskwhyclimbthehighestmountainwhythirtyfiveyearsagoflytheatlanticwhyd
oesriceplaytexaswechoosetogotothemoonwechoosetogotothemoonwechoosetogotothemooninthisdecadeanddotheotherthingsnotbecausetheyareeasybutbecausetheyarehardbecauset
hatgoalwillservetoorganizeandmeasurethebestofourenergiesandskillsbecausethatchallengeisonethatwearewillingtoacceptonewеareunwillingtopostponeandoneweintendtowin
andtheotherstoo
--------------------------------
>> Would you like to try another key? (Y/N)
```

Finally, we find that our final key is “AGBVD,” after around 20 attempts.

```
================================================================================================
>> Here is your final cipher:
wesetsailonthisnewseabecausethereisnewknowledgetobegainedandnewrightstobewonandtheymustbewonandusedfortheprogressofallpeopleforspacesciencelikenuclearscienceand
alltechnologyhasnoconscienceofitsownwhetheritwillbecomeaforceforgoodorilldependsonmanandonlyiftheunitedstatesoccupiesapositionofpreeminencecanwehelpdecidewhethe
rthisnewoceanwillbeaseaofpeaceoranewterrifyingtheaterofwaridonotsaythatweshouldorwillgounprotectedagainstthehostilemisuseofspaceanymorethanwegounprotectedagains
tthehostileuseoflandorseabutidosaythatspacecanbeexploredandmasteredwithoutfeedingthefiresofwarwithoutrepeatingthemistakesthatmanhasmadeinextendinghiswritaroundt
hisglobeofourstherеisnostrifenoprejudicenonationalconflictinouterspaceasyetitshazardsarehostiletousallitsconquestdeservesthebestofallmankindanditsopportunityfor
peacefulcooperationmaynevercomeagainbutwhysomesaythemoonwhychoosethisasourgoalandtheymaywellaskwhyclimbthehighestmountainwhythirtyfiveyearsagoflytheatlanticwhyd
oesriceplaytexaswechoosetogotothemoonwechoosetogotothemoonwechoosetogotothemooninthisdecadeanddotheotherthingsnotbecausetheyareeasybutbecausetheyarehardbecauset
hatgoalwillservetoorganizeandmeasurethebestofourenergiesandskillsbecausethatchallengeisonethatwearewillingtoacceptonewеareunwillingtopostponeandoneweintendtowin
andtheotherstoo
================================================================================================
```