In [1]:

```
# Dependencies and Setup
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
import requests
import time
import pprint
import json
import os
```

In [2]:

```
# Import the files per year
file_2019 = 'Data_to_clean/all_contracts_prime_transactions_2019.csv'
file_2018 = 'Data_to_clean/all_contracts_prime_transactions_2018.csv'
file_2017 = 'Data_to_clean/all_contracts_prime_transactions_2017.csv'
file_2016 = 'Data_to_clean/all_contracts_prime_transactions_2016.csv'
file_2015 = 'Data_to_clean/all_contracts_prime_transactions_2015.csv'
file_2014 = 'Data_to_clean/all_contracts_prime_transactions_2014.csv'
file_2013 = 'Data_to_clean/all_contracts_prime_transactions_2013.csv'
file_2012 = 'Data_to_clean/all_contracts_prime_transactions_2012.csv'
#file_2011 = 'Data_to_clean/all_contracts_prime_transactions_2011.csv'
df_2019 = pd.read_csv(file_2019)
df_2018 = pd.read_csv(file_2018)
df_2017 = pd.read_csv(file_2017)
df_2016 = pd.read_csv(file_2016)
df_2015 = pd.read_csv(file_2015)
df_2014 = pd.read_csv(file_2014)
df_2013 = pd.read_csv(file_2013)
df_2012 = pd.read_csv(file_2012)
#df_2011 = pd.read_csv(file_2011)
```

```
C:\Users\yorch\Anaconda3\lib\site-packages\IPython\core\interactiveshell.py:3
049: DtypeWarning: Columns (21,30,39,55,56,87,88,115,116,159,160) have mixed
types. Specify dtype option on import or set low_memory=False.
  interactivity=interactivity, compiler=compiler, result=result)
C:\Users\yorch\Anaconda3\lib\site-packages\IPython\core\interactiveshell.py:3
049: DtypeWarning: Columns (21,30,39,55,56,73,87,88,115,116,159,160) have mix
ed types. Specify dtype option on import or set low_memory=False.
  interactivity=interactivity, compiler=compiler, result=result)
C:\Users\yorch\Anaconda3\lib\site-packages\IPython\core\interactiveshell.py:3
049: DtypeWarning: Columns (3,21,30,39,56,87,88,115,116,159,160) have mixed t
ypes. Specify dtype option on import or set low_memory=False.
  interactivity=interactivity, compiler=compiler, result=result)
C:\Users\yorch\Anaconda3\lib\site-packages\IPython\core\interactiveshell.py:3
049: DtypeWarning: Columns (3,21,30,39,55,56,73,159,160) have mixed types. Sp
ecify dtype option on import or set low_memory=False.
  interactivity=interactivity, compiler=compiler, result=result)
C:\Users\yorch\Anaconda3\lib\site-packages\IPython\core\interactiveshell.py:3
049: DtypeWarning: Columns (3,21,26,30,39,40,49,54,55,56,63,73,115,116,159,16
0) have mixed types. Specify dtype option on import or set low_memory=False.
  interactivity=interactivity, compiler=compiler, result=result)
C:\Users\yorch\Anaconda3\lib\site-packages\IPython\core\interactiveshell.py:3
049: DtypeWarning: Columns (3,21,26,30,40,45,266,268,270,272,274) have mixed
types. Specify dtype option on import or set low_memory=False.
  interactivity=interactivity, compiler=compiler, result=result)
C:\Users\yorch\Anaconda3\lib\site-packages\IPython\core\interactiveshell.py:3
049: DtypeWarning: Columns (21,30,55,56,115,159,160,266,268,270,272,274) have
mixed types. Specify dtype option on import or set low_memory=False.
  interactivity=interactivity, compiler=compiler, result=result)
C:\Users\yorch\Anaconda3\lib\site-packages\IPython\core\interactiveshell.py:3
049: DtypeWarning: Columns (3,8,21,30,32,49,53,55,56,63,97,98,115,159,160,26
6,268,270,272,274) have mixed types. Specify dtype option on import or set lo
w_memory=False.
  interactivity=interactivity, compiler=compiler, result=result)
```

In [3]:

```
# Print the amount of data we have for each year
print(f"Number of rows in 2019 data: {len(df_2019['award_id_piid'])}")
print(f"Number of rows in 2018 data: {len(df_2018['award_id_piid'])}")
print(f"Number of rows in 2017 data: {len(df_2017['award_id_piid'])}")
print(f"Number of rows in 2016 data: {len(df_2016['award_id_piid'])}")
print(f"Number of rows in 2015 data: {len(df_2015['award_id_piid'])}")
print(f"Number of rows in 2014 data: {len(df_2014['award_id_piid'])}")
print(f"Number of rows in 2013 data: {len(df_2013['award_id_piid'])}")
print(f"Number of rows in 2012 data: {len(df_2012['award_id_piid'])}")
#print(f"Number of rows in 2011 data: {len(df_2011['award_id_piid'])}")
```

```
Number of rows in 2019 data: 67396
Number of rows in 2018 data: 76785
Number of rows in 2017 data: 82985
Number of rows in 2016 data: 80696
Number of rows in 2015 data: 84112
Number of rows in 2014 data: 87627
Number of rows in 2013 data: 82889
Number of rows in 2012 data: 81966
```

In [4]:

```
# Print the number of columns we currently have for each year
print(f"Number of columns in 2019 data: {len(df_2019.columns)}")
print(f"Number of columns in 2018 data: {len(df_2018.columns)}")
print(f"Number of columns in 2017 data: {len(df_2017.columns)}")
print(f"Number of columns in 2016 data: {len(df_2016.columns)}")
print(f"Number of columns in 2015 data: {len(df_2015.columns)}")
print(f"Number of columns in 2014 data: {len(df_2014.columns)}")
print(f"Number of columns in 2013 data: {len(df_2013.columns)}")
print(f"Number of columns in 2012 data: {len(df_2012.columns)}")
#print(f"Number of columns in 2011 data: {len(df_2011.columns)}")
```

```
Number of columns in 2019 data: 277
Number of columns in 2018 data: 277
Number of columns in 2017 data: 277
Number of columns in 2016 data: 277
Number of columns in 2015 data: 277
Number of columns in 2014 data: 277
Number of columns in 2013 data: 277
Number of columns in 2012 data: 277
```

In [5]:

```
# Show all of the columns within the spreadsheets
for column in df_2019.columns:
    print(column)
```

```
contract_transaction_unique_key
contract_award_unique_key
award_id_piid
modification_number
transaction_number
parent_award_agency_id
parent_award_agency_name
parent_award_id
parent_award_modification_number
federal_action_obligation
total_dollars_obligated
base_and_exercised_options_value
current_total_value_of_award
base_and_all_options_value
potential_total_value_of_award
action_date
action_date_fiscal_year
period_of_performance_start_date
period_of_performance_current_end_date
period_of_performance_potential_end_date
ordering_period_end_date
solicitation_date
awarding_agency_code
awarding_agency_name
awarding_sub_agency_code
awarding_sub_agency_name
awarding_office_code
awarding_office_name
funding_agency_code
funding_agency_name
funding_sub_agency_code
funding_sub_agency_name
funding_office_code
funding_office_name
treasury_accounts_funding_this_award
federal_accounts_funding_this_award
foreign_funding
foreign_funding_description
sam_exception
sam_exception_description
recipient_duns
recipient_name
recipient_doing_business_as_name
cage_code
recipient_parent_name
recipient_parent_duns
recipient_country_code
recipient_country_name
recipient_address_line_1
recipient_address_line_2
recipient_city_name
recipient_state_code
recipient_state_name
recipient_zip_4_code
recipient_congressional_district
recipient_phone_number
recipient_fax_number
```

```
primary_place_of_performance_country_code
primary_place_of_performance_country_name
primary_place_of_performance_city_name
primary_place_of_performance_county_name
primary_place_of_performance_state_code
primary_place_of_performance_state_name
primary_place_of_performance_zip_4
primary_place_of_performance_congressional_district
award_or_idv_flag
award_type_code
award_type
idv_type_code
idv_type
multiple_or_single_award_idv_code
multiple_or_single_award_idv
type_of_idc_code
type_of_idc
type_of_contract_pricing_code
type_of_contract_pricing
award_description
action_type_code
action_type
solicitation_identifier
number_of_actions
inherently_governmental_functions
inherently_governmental_functions_description
product_or_service_code
product_or_service_code_description
contract_bundling_code
contract_bundling
dod_claimant_program_code
dod_claimant_program_description
naics_code
naics_description
recovered_materials_sustainability_code
recovered_materials_sustainability
domestic_or_foreign_entity_code
domestic_or_foreign_entity
dod_acquisition_program_code
dod_acquisition_program_description
information_technology_commercial_item_category_code
information_technology_commercial_item_category
epa_designated_product_code
epa_designated_product
country_of_product_or_service_origin_code
country_of_product_or_service_origin
place_of_manufacture_code
place_of_manufacture
subcontracting_plan_code
subcontracting_plan
extent_competed_code
extent_competed
solicitation_procedures_code
solicitation_procedures
type_of_set_aside_code
type_of_set_aside
evaluated_preference_code
```

```
evaluated_preference
research_code
research
fair_opportunity_limited_sources_code
fair_opportunity_limited_sources
other_than_full_and_open_competition_code
other_than_full_and_open_competition
number_of_offers_received
commercial_item_acquisition_procedures_code
commercial_item_acquisition_procedures
small_business_competitiveness_demonstration_program
commercial_item_test_program_code
commercial_item_test_program
a76_fair_act_action_code
a76_fair_act_action
fed_biz_opps_code
fed_biz_opps
local_area_set_aside_code
local_area_set_aside
price_evaluation_adjustment_preference_percent_difference
clinger_cohen_act_planning_code
clinger_cohen_act_planning
materials_supplies_articles_equipment_code
materials_supplies_articles_equipment
labor_standards_code
labor_standards
construction_wage_rate_requirements_code
construction_wage_rate_requirements
interagency_contracting_authority_code
interagency_contracting_authority
other_statutory_authority
program_acronym
parent_award_type_code
parent_award_type
parent_award_single_or_multiple_code
parent_award_single_or_multiple
major_program
national_interest_action_code
national_interest_action
cost_or_pricing_data_code
cost_or_pricing_data
cost_accounting_standards_clause_code
cost_accounting_standards_clause
gfe_gfp_code
gfe_gfp
sea_transportation_code
sea_transportation
undefinitized_action_code
undefinitized_action
consolidated_contract_code
consolidated_contract
performance_based_service_acquisition_code
performance_based_service_acquisition
multi_year_contract_code
multi_year_contract
contract_financing_code
contract_financing
```

```
purchase_card_as_payment_method_code
purchase_card_as_payment_method
contingency_humanitarian_or_peacekeeping_operation_code
contingency_humanitarian_or_peacekeeping_operation
alaskan_native_owned_corporation_or_firm
american_indian_owned_business
indian_tribe_federally_recognized
native_hawaiian_owned_business
tribally_owned_business
veteran_owned_business
service_disabled_veteran_owned_business
woman_owned_business
women_owned_small_business
economically_disadvantaged_women_owned_small_business
joint_venture_women_owned_small_business
joint_venture_economic_disadvantaged_women_owned_small_bus
minority_owned_business
subcontinent_asian_asian_indian_american_owned_business
asian_pacific_american_owned_business
black_american_owned_business
hispanic_american_owned_business
native_american_owned_business
other_minority_owned_business
contracting_officers_determination_of_business_size
contracting_officers_determination_of_business_size_code
emerging_small_business
community_developed_corporation_owned_firm
labor_surplus_area_firm
us_federal_government
federally_funded_research_and_development_corp
federal_agency
us_state_government
us_local_government
city_local_government
county_local_government
inter_municipal_local_government
local_government_owned
municipality_local_government
school_district_local_government
township_local_government
us_tribal_government
foreign_government
organizational_type
corporate_entity_not_tax_exempt
corporate_entity_tax_exempt
partnership_or_limited_liability_partnership
sole_proprietorship
small_agricultural_cooperative
international_organization
us_government_entity
community_development_corporation
domestic_shelter
educational_institution
foundation
hospital_flag
manufacturer_of_goods
veterinary_hospital
```

```
hispanic_servicing_institution
receives_contracts
receives_grants
receives_contracts_and_grants
airport_authority
council_of_governments
housing_authorities_public_tribal
interstate_entity
planning_commission
port_authority
transit_authority
subchapter_scorporation
limited_liability_corporation
foreign_owned_and_located
for_profit_organization
nonprofit_organization
other_not_for_profit_organization
the_ability_one_program
number_of_employees
annual_revenue
private_university_or_college
state_controlled_institution_of_higher_learning
1862_land_grant_college
1890_land_grant_college
1994_land_grant_college
minority_institution
historically_black_college
tribal_college
alaskan_native_servicing_institution
native_hawaiian_servicing_institution
school_of_forestry
veterinary_college
dot_certified_disadvantage
self_certified_small_disadvantaged_business
small_disadvantaged_business
c8a_program_participant
historically_underutilized_business_zone_hubzone_firm
sba_certified_8a_joint_venture
highly_compensated_officer_1_name
highly_compensated_officer_1_amount
highly_compensated_officer_2_name
highly_compensated_officer_2_amount
highly_compensated_officer_3_name
highly_compensated_officer_3_amount
highly_compensated_officer_4_name
highly_compensated_officer_4_amount
highly_compensated_officer_5_name
highly_compensated_officer_5_amount
last_modified_date
```

In [6]:

```
# Take out all of the rows we know will not be needed at this time
columns_to_drop = ['parent_award_agency_id','parent_award_id','potential_total
_value_of_award','base_and_exercised_options_value',
                              'current_total_value_of_award','base_and_all_opt
ions_value','ordering_period_end_date',
                              'awarding_agency_code','awarding_sub_agency_cod
e','awarding_office_code','funding_agency_code',
                              'funding_sub_agency_code','funding_office_code',
'sam_exception','sam_exception_description','recipient_duns','recipient_doing_
business_as_name',
                              'cage_code','recipient_parent_duns','recipient_c
ountry_code','recipient_address_line_2','recipient_state_code','domestic_shelt
er',
                              'community_development_corporation', 'us_governm
ent_entity','international_organization','small_agricultural_cooperative',
                              'sole_proprietorship','partnership_or_limited_li
ability_partnership','corporate_entity_tax_exempt','corporate_entity_not_tax_e
xempt',
                              'us_tribal_government','township_local_governmen
t','school_district_local_government','municipality_local_government',
                              'local_government_owned','inter_municipal_local_
government','county_local_government','city_local_government',
                              'us_local_government','us_state_government','fed
erally_funded_research_and_development_corp','us_federal_government',
                              'labor_surplus_area_firm','organizational_type',
'foreign_government','indian_tribe_federally_recognized','native_hawaiian_owne
d_business',
                               'contingency_humanitarian_or_peacekeeping_opera
tion_code','purchase_card_as_payment_method_code',
                               'contract_financing','contract_financing_code',
'multi_year_contract_code','performance_based_service_acquisition',
                               'performance_based_service_acquisition_code','c
onsolidated_contract','consolidated_contract_code','undefinitized_action',
                               'undefinitized_action_code','sea_transportatio
n','sea_transportation_code','gfe_gfp','gfe_gfp_code','cost_accounting_standar
ds_clause',
                               'cost_accounting_standards_clause_code','cost_o
r_pricing_data','cost_or_pricing_data_code','national_interest_action_code',
                               'parent_award_single_or_multiple_code','parent_
award_type','parent_award_type_code','program_acronym',
                               'other_statutory_authority','interagency_contra
cting_authority','interagency_contracting_authority_code',
                               'construction_wage_rate_requirements_code','lab
or_standards_code','materials_supplies_articles_equipment',
                               'materials_supplies_articles_equipment_code','c
linger_cohen_act_planning','clinger_cohen_act_planning_code',
                               'price_evaluation_adjustment_preference_percent
_difference','local_area_set_aside','local_area_set_aside_code',
                               'fed_biz_opps_code','a76_fair_act_action_code',
'commercial_item_test_program','commercial_item_test_program_code','commercial
_item_acquisition_procedures',
                               'commercial_item_acquisition_procedures_code',
'fair_opportunity_limited_sources_code','research_code','evaluated_preference'
,
                               'evaluated_preference_code','type_of_set_aside_
code','solicitation_procedures_code','extent_competed_code',
                               'subcontracting_plan_code','place_of_manufactur
e_code','country_of_product_or_service_origin_code',
                               'epa_designated_product','epa_designated_produc
t_code','information_technology_commercial_item_category',
                               'information_technology_commercial_item_categor
y_code','dod_acquisition_program_description','dod_acquisition_program_code',
                               'domestic_or_foreign_entity_code','recovered_ma
terials_sustainability_code','naics_code',
                               'dod_claimant_program_description','dod_claiman
t_program_code','contract_bundling','contract_bundling_code',
                               'inherently_governmental_functions_description'
,'inherently_governmental_functions','solicitation_identifier',
                               'action_type_code','type_of_contract_pricing_co
de','type_of_idc','type_of_idc_code','multiple_or_single_award_idv',
                               'multiple_or_single_award_idv_code','idv_type',
'idv_type_code','award_type_code','award_or_idv_flag',
                               'primary_place_of_performance_congressional_dis
trict','primary_place_of_performance_zip_4','primary_place_of_performance_stat
e_code',
                               'primary_place_of_performance_county_name','pri
mary_place_of_performance_country_code',
                               'recipient_fax_number','recipient_phone_number'
,'recipient_congressional_district','recipient_zip_4_code',
                               'foreign_funding_description','foreign_funding'
,'federal_accounts_funding_this_award','treasury_accounts_funding_this_award',
                               'ordering_period_end_date','period_of_performan
ce_potential_end_date','parent_award_modification_number',
                               'transaction_number','highly_compensated_office
r_5_amount','highly_compensated_officer_5_name',
                             'highly_compensated_officer_4_amount','highly_com
pensated_officer_4_name',
                             'highly_compensated_officer_3_amount','highly_com
pensated_officer_3_name',
                             'highly_compensated_officer_2_amount','highly_com
pensated_officer_2_name',
                             'highly_compensated_officer_1_amount','highly_com
pensated_officer_1_name',
                             'last_modified_date','veterinary_college','school
_of_forestry','native_hawaiian_servicing_institution',
                             'alaskan_native_servicing_institution','tribal_co
llege','historically_black_college','minority_institution',
                             '1994_land_grant_college','1890_land_grant_colleg
e','1862_land_grant_college','1862_land_grant_college','state_controlled_insti
tution_of_higher_learning',
                             'private_university_or_college','annual_revenue',
'number_of_employees','the_ability_one_program','other_not_for_profit_organiza
tion',
                             'nonprofit_organization','limited_liability_corpo
ration','subchapter_scorporation','transit_authority','port_authority',
                             'planning_commission','interstate_entity','housin
g_authorities_public_tribal','council_of_governments',
                             'airport_authority','receives_contracts_and_grant
s','receives_grants','receives_contracts',
                             'hispanic_servicing_institution','veterinary_hosp
ital','manufacturer_of_goods','hospital_flag','foundation','educational_instit
ution']
df_2019_clean = df_2019.drop(columns_to_drop, axis=1)
```

```
df_2018_clean = df_2018.drop(columns_to_drop, axis=1)
df_2017_clean = df_2017.drop(columns_to_drop, axis=1)
df_2016_clean = df_2016.drop(columns_to_drop, axis=1)
df_2015_clean = df_2015.drop(columns_to_drop, axis=1)
df_2014_clean = df_2014.drop(columns_to_drop, axis=1)
df_2013_clean = df_2013.drop(columns_to_drop, axis=1)
df_2012_clean = df_2012.drop(columns_to_drop, axis=1)
#df_2011_clean = df_2011.drop(columns_to_drop, axis=1)
```

In [7]:

```
# Show the columns that we dropped
for column in columns_to_drop:
    print(column)
```

```
parent_award_agency_id
parent_award_id
potential_total_value_of_award
base_and_exercised_options_value
current_total_value_of_award
base_and_all_options_value
ordering_period_end_date
awarding_agency_code
awarding_sub_agency_code
awarding_office_code
funding_agency_code
funding_sub_agency_code
funding_office_code
sam_exception
sam_exception_description
recipient_duns
recipient_doing_business_as_name
cage_code
recipient_parent_duns
recipient_country_code
recipient_address_line_2
recipient_state_code
domestic_shelter
community_development_corporation
us_government_entity
international_organization
small_agricultural_cooperative
sole_proprietorship
partnership_or_limited_liability_partnership
corporate_entity_tax_exempt
corporate_entity_not_tax_exempt
us_tribal_government
township_local_government
school_district_local_government
municipality_local_government
local_government_owned
inter_municipal_local_government
county_local_government
city_local_government
us_local_government
us_state_government
federally_funded_research_and_development_corp
us_federal_government
labor_surplus_area_firm
organizational_type
foreign_government
indian_tribe_federally_recognized
native_hawaiian_owned_business
contingency_humanitarian_or_peacekeeping_operation_code
purchase_card_as_payment_method_code
contract_financing
contract_financing_code
multi_year_contract_code
performance_based_service_acquisition
performance_based_service_acquisition_code
consolidated_contract
consolidated_contract_code
```

```
undefinitized_action
undefinitized_action_code
sea_transportation
sea_transportation_code
gfe_gfp
gfe_gfp_code
cost_accounting_standards_clause
cost_accounting_standards_clause_code
cost_or_pricing_data
cost_or_pricing_data_code
national_interest_action_code
parent_award_single_or_multiple_code
parent_award_type
parent_award_type_code
program_acronym
other_statutory_authority
interagency_contracting_authority
interagency_contracting_authority_code
construction_wage_rate_requirements_code
labor_standards_code
materials_supplies_articles_equipment
materials_supplies_articles_equipment_code
clinger_cohen_act_planning
clinger_cohen_act_planning_code
price_evaluation_adjustment_preference_percent_difference
local_area_set_aside
local_area_set_aside_code
fed_biz_opps_code
a76_fair_act_action_code
commercial_item_test_program
commercial_item_test_program_code
commercial_item_acquisition_procedures
commercial_item_acquisition_procedures_code
fair_opportunity_limited_sources_code
research_code
evaluated_preference
evaluated_preference_code
type_of_set_aside_code
solicitation_procedures_code
extent_competed_code
subcontracting_plan_code
place_of_manufacture_code
country_of_product_or_service_origin_code
epa_designated_product
epa_designated_product_code
information_technology_commercial_item_category
information_technology_commercial_item_category_code
dod_acquisition_program_description
dod_acquisition_program_code
domestic_or_foreign_entity_code
recovered_materials_sustainability_code
naics_code
dod_claimant_program_description
dod_claimant_program_code
contract_bundling
contract_bundling_code
inherently_governmental_functions_description
```

```
inherently_governmental_functions
solicitation_identifier
action_type_code
type_of_contract_pricing_code
type_of_idc
type_of_idc_code
multiple_or_single_award_idv
multiple_or_single_award_idv_code
idv_type
idv_type_code
award_type_code
award_or_idv_flag
primary_place_of_performance_congressional_district
primary_place_of_performance_zip_4
primary_place_of_performance_state_code
primary_place_of_performance_county_name
primary_place_of_performance_country_code
recipient_fax_number
recipient_phone_number
recipient_congressional_district
recipient_zip_4_code
foreign_funding_description
foreign_funding
federal_accounts_funding_this_award
treasury_accounts_funding_this_award
ordering_period_end_date
period_of_performance_potential_end_date
parent_award_modification_number
transaction_number
highly_compensated_officer_5_amount
highly_compensated_officer_5_name
highly_compensated_officer_4_amount
highly_compensated_officer_4_name
highly_compensated_officer_3_amount
highly_compensated_officer_3_name
highly_compensated_officer_2_amount
highly_compensated_officer_2_name
highly_compensated_officer_1_amount
highly_compensated_officer_1_name
last_modified_date
veterinary_college
school_of_forestry
native_hawaiian_servicing_institution
alaskan_native_servicing_institution
tribal_college
historically_black_college
minority_institution
1994_land_grant_college
1890_land_grant_college
1862_land_grant_college
1862_land_grant_college
state_controlled_institution_of_higher_learning
private_university_or_college
annual_revenue
number_of_employees
the_ability_one_program
other_not_for_profit_organization
```

```
nonprofit_organization
limited_liability_corporation
subchapter_scorporation
transit_authority
port_authority
planning_commission
interstate_entity
housing_authorities_public_tribal
council_of_governments
airport_authority
receives_contracts_and_grants
receives_grants
receives_contracts
hispanic_servicing_institution
veterinary_hospital
manufacturer_of_goods
hospital_flag
foundation
educational_institution
```

In [8]:

```
# Ensure that each dataframe only has data for a single year
print(f"2019 dataframe has data for: {df_2019_clean['action_date_fiscal_year'].unique()}")
print(f"2018 dataframe has data for: {df_2018_clean['action_date_fiscal_year'].unique()}")
print(f"2017 dataframe has data for: {df_2017_clean['action_date_fiscal_year'].unique()}")
print(f"2016 dataframe has data for: {df_2016_clean['action_date_fiscal_year'].unique()}")
print(f"2015 dataframe has data for: {df_2015_clean['action_date_fiscal_year'].unique()}")
print(f"2014 dataframe has data for: {df_2014_clean['action_date_fiscal_year'].unique()}")
print(f"2013 dataframe has data for: {df_2013_clean['action_date_fiscal_year'].unique()}")
print(f"2012 dataframe has data for: {df_2012_clean['action_date_fiscal_year'].unique()}")
#print(f"2011 dataframe has data for: {df_2011_clean['action_date_fiscal_year'].unique()}")
```

```
2019 dataframe has data for: [2019]
2018 dataframe has data for: [2018]
2017 dataframe has data for: [2017]
2016 dataframe has data for: [2016]
2015 dataframe has data for: [2015]
2014 dataframe has data for: [2014]
2013 dataframe has data for: [2013]
2012 dataframe has data for: [2012]
```

In [9]:

```
# Combine all years into a single dataframe
total_cleaned_data = df_2019_clean
total_cleaned_data = total_cleaned_data.append(df_2018_clean)
total_cleaned_data = total_cleaned_data.append(df_2017_clean)
total_cleaned_data = total_cleaned_data.append(df_2016_clean)
total_cleaned_data = total_cleaned_data.append(df_2015_clean)
total_cleaned_data = total_cleaned_data.append(df_2014_clean)
total_cleaned_data = total_cleaned_data.append(df_2013_clean)
total_cleaned_data = total_cleaned_data.append(df_2012_clean)
#total_cleaned_data = total_cleaned_data.append(df_2011_clean)
```

In [10]:

```
# Show the amount of data we have for each column
total_cleaned_data.count()
```

```
Out[10]: contract_transaction_unique_key                               644456
         contract_award_unique_key                                     644456
         award_id_piid                                                 644456
         modification_number                                           644456
         parent_award_agency_name                                      387899
         federal_action_obligation                                     644456
         total_dollars_obligated                                       209102
         action_date                                                   644456
         action_date_fiscal_year                                       644456
         period_of_performance_start_date                              644456
         period_of_performance_current_end_date                        644455
         solicitation_date                                               3153
         awarding_agency_name                                          644456
         awarding_sub_agency_name                                      644456
         awarding_office_name                                          644455
         funding_agency_name                                           644456
         funding_sub_agency_name                                       644456
         funding_office_name                                           644430
         recipient_name                                                644261
         recipient_parent_name                                         642823
         recipient_country_name                                        481190
         recipient_address_line_1                                      644076
         recipient_city_name                                           644138
         recipient_state_name                                          482925
         primary_place_of_performance_country_name                     644455
         primary_place_of_performance_city_name                        637507
         primary_place_of_performance_state_name                       637689
         award_type                                                    644456
         type_of_contract_pricing                                      640486
         award_description                                             644450
                                                                        ...  
         alaskan_native_owned_corporation_or_firm                      644456
         american_indian_owned_business                                644456
         tribally_owned_business                                       644456
         veteran_owned_business                                        644456
         service_disabled_veteran_owned_business                       644456
         woman_owned_business                                          644456
         women_owned_small_business                                    644456
         economically_disadvantaged_women_owned_small_business         644456
         joint_venture_women_owned_small_business                      644456
         joint_venture_economic_disadvantaged_women_owned_small_bus    644456
         minority_owned_business                                       644456
         subcontinent_asian_asian_indian_american_owned_business       644456
         asian_pacific_american_owned_business                         644456
         black_american_owned_business                                 644456
         hispanic_american_owned_business                              644456
         native_american_owned_business                                644456
         other_minority_owned_business                                 644456
         contracting_officers_determination_of_business_size           644453
         contracting_officers_determination_of_business_size_code      644453
         emerging_small_business                                       644456
         community_developed_corporation_owned_firm                    644456
         federal_agency                                                644456
         foreign_owned_and_located                                     644456
         for_profit_organization                                       644456
         dot_certified_disadvantage                                    644456
         self_certified_small_disadvantaged_business                   644456
```

```
small_disadvantaged_business                            644456
c8a_program_participant                                 644456
historically_underutilized_business_zone_hubzone_firm   644456
sba_certified_8a_joint_venture                          644456
Length: 89, dtype: int64
```

In [11]:

```
# Export final dataframe to CSV
#total_cleaned_data.to_csv("Annual_HSS_Data_Cleaned.csv", index=False)
```

In [12]:

```
total_cleaned_data.head()
```

Out[12]:

	contract_transaction_unique_key	contract_award_unique_key	award_id_piid
0	7523_-NONE-_75D30118C01909_P00001_-NONE-_0	CONT_AWD_75D30118C01909_7523_-NONE-_-NONE-	75D30118C01909
1	7523_-NONE-_75D30118C02052_P00001_-NONE-_0	CONT_AWD_75D30118C02052_7523_-NONE-_-NONE-	75D30118C02052
2	7523_-NONE-_HHSD200201692404C_3_-NONE-_0	CONT_AWD_HHSD200201692404C_7523_-NONE-_-NONE-	HHSD200201692404C
3	7523_-NONE-_HHSD200201692405C_3_-NONE-_0	CONT_AWD_HHSD200201692405C_7523_-NONE-_-NONE-	HHSD200201692405C
4	7523_-NONE-_HHSD200201692406C_8_-NONE-_0	CONT_AWD_HHSD200201692406C_7523_-NONE-_-NONE-	HHSD200201692406C

5 rows × 89 columns

In [13]:

```
#Available dates
# action_date
# action_date_fiscal_year
# period_of_performance_start_date
# period_of_performance_current_end_date
# solicitation_date

#needed
# contract_award_unique_key
# federal_action_obligation
```

In [14]:
```
small_table = pd.DataFrame(total_cleaned_data['contract_award_unique_key'])
small_table['federal_action_obligation'] = total_cleaned_data['federal_action_obligation']
small_table['action_date'] = total_cleaned_data['action_date']
small_table['action_date_fiscal_year'] = total_cleaned_data['action_date_fiscal_year']
small_table.head()
```

Out[14]:

	contract_award_unique_key	federal_action_obligation	action_date	action_date_fis
0	CONT_AWD_75D30118C01909_7523_-NONE-_-NONE-	0.0	2018-10-02	
1	CONT_AWD_75D30118C02052_7523_-NONE-_-NONE-	0.0	2018-10-02	
2	CONT_AWD_HHSD200201692404C_7523_-NONE-_-NONE-	0.0	2018-10-01	
3	CONT_AWD_HHSD200201692405C_7523_-NONE-_-NONE-	0.0	2018-10-01	
4	CONT_AWD_HHSD200201692406C_7523_-NONE-_-NONE-	0.0	2018-10-01	

In [15]:
```
small_table_grouped = small_table.groupby('action_date_fiscal_year')
table_1 = pd.DataFrame(small_table_grouped['federal_action_obligation'].sum())
table_1
```

Out[15]:

	federal_action_obligation
action_date_fiscal_year	
2012	1.835646e+10
2013	1.976718e+10
2014	2.155077e+10
2015	1.960495e+10
2016	1.989308e+10
2017	2.245030e+10
2018	2.144154e+10
2019	2.201639e+10

In [16]:

```
years = small_table_grouped['action_date_fiscal_year'].unique()
years
```

Out[16]:

```
action_date_fiscal_year
2012    [2012]
2013    [2013]
2014    [2014]
2015    [2015]
2016    [2016]
2017    [2017]
2018    [2018]
2019    [2019]
Name: action_date_fiscal_year, dtype: object
```

In [33]:

```
amount = table_1['federal_action_obligation']
#pd.options.display.float_format = '{:,.2f}'.format
amount = amount/1000000000
amount = pd.DataFrame(amount)
amount
```

Out[33]:

	federal_action_obligation
action_date_fiscal_year	
2012	18.356459
2013	19.767176
2014	21.550774
2015	19.604947
2016	19.893077
2017	22.450301
2018	21.441538
2019	22.016393

In [18]:

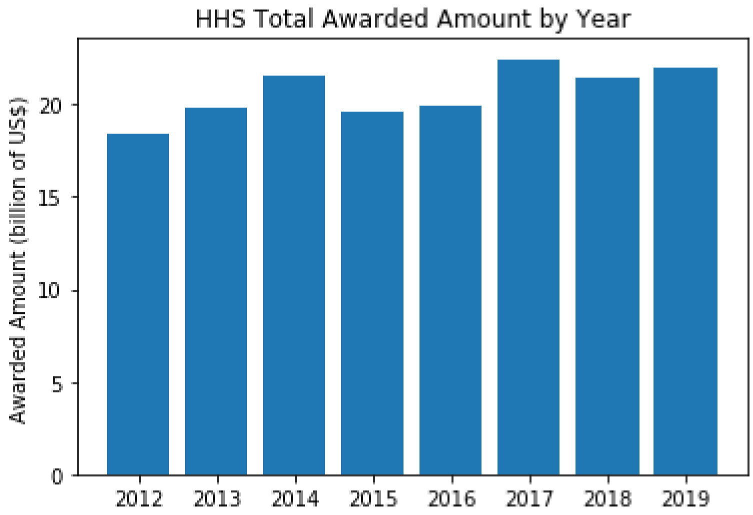
```
#Simple plot of total amount per year

fig, ax = plt.subplots()

chart_1 = ax.bar(years, amount)
ax.set_ylabel('Awarded Amount (billion of US$)')
ax.set_title('HHS Total Awarded Amount by Year')

plt.figure(figsize=(30,30))

plt.show()
```



```
<Figure size 2160x2160 with 0 Axes>
```

In [19]:

```
#Add a column with only the month from each date
#This is the final table to work with
small_table['month'] = pd.DatetimeIndex(small_table['action_date']).month
small_table.head()
```

Out[19]:

	contract_award_unique_key	federal_action_obligation	action_date	action_date_fis
0	CONT_AWD_75D30118C01909_7523_-NONE-_-NONE-	0.0	2018-10-02	
1	CONT_AWD_75D30118C02052_7523_-NONE-_-NONE-	0.0	2018-10-02	
2	CONT_AWD_HHSD200201692404C_7523_-NONE-_-NONE-	0.0	2018-10-01	
3	CONT_AWD_HHSD200201692405C_7523_-NONE-_-NONE-	0.0	2018-10-01	
4	CONT_AWD_HHSD200201692406C_7523_-NONE-_-NONE-	0.0	2018-10-01	

In [20]:

```
#count how many contracts were awarded each month
#this defines the code for the first chart
small_table_g2 = small_table.groupby(['action_date_fiscal_year','month'])
small_table_g2 = small_table_g2["contract_award_unique_key"].count()
small_table_g2 = pd.DataFrame(small_table_g2)
small_table_g2.head()



# Use df.plot use line as the graph type
# Your dimensions should be configured by way of your indexes (year and month)
# Holler @ me if you get stuck
```

Out[20]:

		contract_award_unique_key
action_date_fiscal_year	**month**	
2012	**1**	6206
	2	5618
	3	6426
	4	5490
	5	6174

In [21]:

```
pivot_table = pd.pivot_table(small_table_g2, values = 'contract_award_unique_key', index = "month", columns = "action_date_fiscal_year")
pivot_table
```

Out[21]:

action_date_fiscal_year	2012	2013	2014	2015	2016	2017	2018	2019
month								
1	6206	5683	6209	5925	4958	6511	5464	4253
2	5618	5074	6409	5812	6155	5760	5703	5355
3	6426	6332	7679	8150	7477	7357	6635	5713
4	5490	6870	7047	6934	6631	6409	5484	5620
5	6174	7182	7044	5967	6303	6515	6728	5834
6	6486	6991	7609	7323	7247	6705	6746	6196
7	7099	8516	8350	8293	7041	7076	8062	6300
8	10948	11117	9551	9634	9829	10538	9226	7889
9	11980	12541	12353	12221	11817	12606	10091	9221
10	3907	2915	2864	3515	3340	2658	2872	2717
11	5535	5001	5521	4522	4915	5526	4758	4145
12	6097	4667	6991	5816	4983	5324	5016	4153

In [ ]:

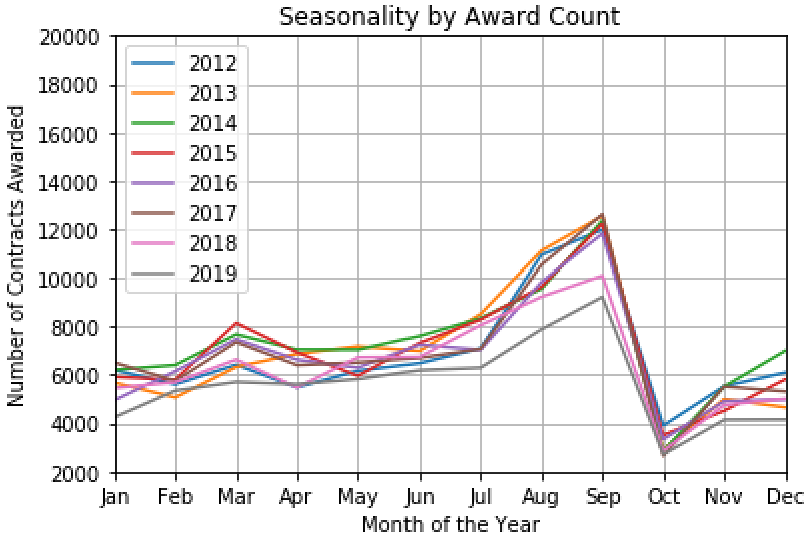
```
```

In [22]:

```
#build seasonality chart
#pivot_table.plot()
#lines = pivot_table.plot.line(subplots = True)
lines = pivot_table.plot.line()
#handles = [2011,2012,2013,2014,2015,2016,2017,2018,2019]
plt.legend(loc="upper left")
plt.title("Seasonality by Award Count")
plt.xlabel("Month of the Year")
plt.ylabel("Number of Contracts Awarded")
plt.grid()
plt.ylim(2000, 20000)
plt.xticks(np.arange(1, 13, 1),('Jan','Feb','Mar','Apr','May','Jun','Jul','Aug','Sep','Oct','Nov','Dec'))

plt.savefig("Seasonality1.png")

plt.show()
```



In [23]:

```
#this defines the code for the second chart
small_table_g3 = small_table.groupby(['action_date_fiscal_year','month'])
small_table_g3 = small_table_g3["federal_action_obligation"].sum()
small_table_g3 = pd.DataFrame(small_table_g3)/1000000000
small_table_g3.head()
```

Out[23]:

		federal_action_obligation
action_date_fiscal_year	**month**	
2012	**1**	0.672068
	2	1.139795
	3	1.321782
	4	0.974864
	5	1.694266

In [24]:
```
pivot_table_g3 = pd.pivot_table(small_table_g3, values = 'federal_action_oblig
ation', index = "month", columns = "action_date_fiscal_year")
pivot_table_g3
```

Out[24]:

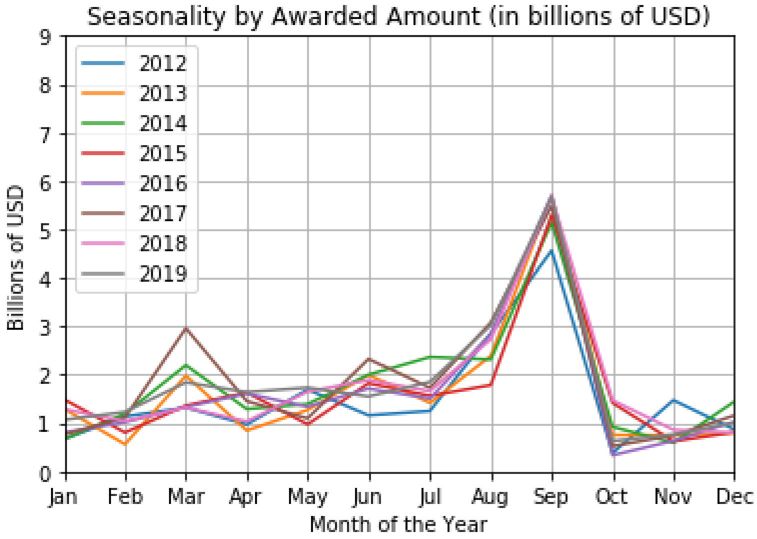
action_date_fiscal_year	2012	2013	2014	2015	2016	2017	2018	
month								
1	0.672068	1.295900	0.672019	1.490655	0.808164	0.765413	1.288000	1.
2	1.139795	0.563613	1.197205	0.806403	1.019942	1.115881	1.044577	1.
3	1.321782	1.980478	2.198831	1.364586	1.334295	2.962688	1.323575	1.
4	0.974864	0.848594	1.292529	1.632783	1.611625	1.455673	1.036895	1.
5	1.694266	1.274242	1.395635	0.976755	1.340800	1.100592	1.652475	1.
6	1.163054	1.997141	2.003001	1.824692	1.716404	2.327092	1.888662	1.
7	1.252456	1.420467	2.368088	1.567293	1.507867	1.730440	1.664623	1.
8	2.851355	2.391951	2.317448	1.787139	2.850815	3.080519	2.735051	3.
9	4.559530	5.691073	5.140865	5.296866	5.701752	5.481863	5.668998	5.
10	0.381985	0.755847	0.924867	1.420385	0.337187	0.526235	1.472605	0.
11	1.474850	0.751008	0.595263	0.624453	0.634545	0.744729	0.862969	0.
12	0.870454	0.796863	1.445023	0.812936	1.029680	1.159177	0.803107	1.

In [25]:

```
lines_g3 = pivot_table_g3.plot.line()
#handles = [2011,2012,2013,2014,2015,2016,2017,2018,2019]
plt.legend(loc="upper left")
plt.title("Seasonality by Awarded Amount (in billions of USD)")
plt.xlabel("Month of the Year")
plt.ylabel("Billions of USD")
plt.grid()
plt.ylim(0, 9)
plt.xticks(np.arange(1, 13, 1),('Jan','Feb','Mar','Apr','May','Jun','Jul','Aug','Sep','Oct','Nov','Dec'))

plt.savefig("Seasonality2.png")


plt.show()
```



In [26]:

```
#Chart 3 amounts by award (test if seasonality is diluted)
diluted = pivot_table_g3/pivot_table*1000000
diluted = pd.DataFrame(diluted)
#diluted['Mean'] = diluted.mean(axis=1)
#diluted = pd.DataFrame(diluted)
diluted
```

Out[26]:

action_date_fiscal_year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
month						
1	108.293216	228.031046	108.233117	251.587339	163.002115	117.556900
2	202.882784	111.078605	186.800607	138.747952	165.709472	193.729262
3	205.692785	312.772866	286.343432	167.433916	178.453251	402.703324
4	177.570779	123.521724	183.415469	235.474870	243.044075	227.129520
5	274.419549	177.421668	198.130970	163.692832	212.724033	168.931962
6	179.317614	285.673200	263.241025	249.172800	236.843441	347.068087
7	176.427140	166.799770	283.603408	188.989880	214.155278	244.550532
8	260.445313	215.161521	242.639292	185.503275	290.041169	292.324832
9	380.595141	453.797360	416.163271	433.423247	482.504210	434.861412
10	97.769366	259.295638	322.928361	404.092429	100.954174	197.981504
11	266.458867	150.171477	107.818046	138.092320	129.103832	134.768162
12	142.767551	170.744132	206.697549	139.775835	206.638615	217.726759

In [27]:

```
#Obama Period 2
obama = diluted.drop([2012,2017,2018,2019], axis =1)
obama['Mean Obama'] = obama.median(axis =1)
obama
obama_mean = obama['Mean Obama']
obama_mean
```

Out[27]:

```
month
1     195.516581
2     152.228712
3     232.398341
4     209.445169
5     187.776319
6     256.206913
7     201.572579
8     228.900406
9     443.610303
10    291.112000
11    133.598076
12    188.691374
Name: Mean Obama, dtype: float64
```

In [28]:

```
#Trump
trump = diluted.drop([2012,2013,2014,2015,2016], axis =1)
trump['Mean Trump'] = trump.median(axis =1)
trump
trump_mean = trump['Mean Trump']
trump_mean
```

Out[28]:

```
month
1     235.724662
2     193.729262
3     322.421519
4     227.129520
5     245.611592
6     279.967677
7     244.550532
8     296.450383
9     561.787571
10    232.427971
11    181.372181
12    217.726759
Name: Mean Trump, dtype: float64
```

In [29]:

```
#Mean total Since 2012
allgov = diluted
allgov['Mean All'] = allgov.median(axis =1)
allgov
allgov_mean = allgov['Mean All']
allgov_mean
```

Out[29]:

```
month
1     195.516581
2     184.981671
3     246.018109
4     208.102995
5     205.427502
6     256.914782
7     210.316471
8     275.243241
9     444.329386
10    245.861805
11    144.131899
12    188.691374
Name: Mean All, dtype: float64
```

In [30]:

```
#Dataframe of mean award value by government
mean_df = pd.DataFrame()
mean_df['Obama 2nd'] = obama_mean
mean_df['Trump'] = trump_mean
mean_df['All'] = allgov_mean
mean_df
```

Out[30]:

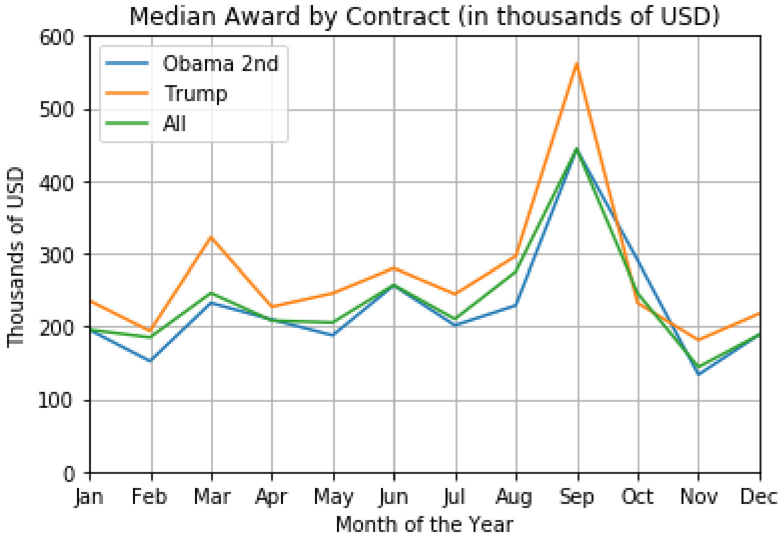
	Obama 2nd	**Trump**	**All**
month			
1	195.516581	235.724662	195.516581
2	152.228712	193.729262	184.981671
3	232.398341	322.421519	246.018109
4	209.445169	227.129520	208.102995
5	187.776319	245.611592	205.427502
6	256.206913	279.967677	256.914782
7	201.572579	244.550532	210.316471
8	228.900406	296.450383	275.243241
9	443.610303	561.787571	444.329386
10	291.112000	232.427971	245.861805
11	133.598076	181.372181	144.131899
12	188.691374	217.726759	188.691374

In [32]:

```
lines_g4 = mean_df.plot()
#handles = [2011,2012,2013,2014,2015,2016,2017,2018,2019]
plt.legend(loc="upper left")
plt.title("Median Award by Contract (in thousands of USD)")
plt.xlabel("Month of the Year")
plt.ylabel("Thousands of USD")
plt.grid()
plt.ylim(0, 600)
plt.xticks(np.arange(1, 13, 1),('Jan','Feb','Mar','Apr','May','Jun','Jul','Aug','Sep','Oct','Nov','Dec'))

plt.savefig("Seasonality3.png")


plt.show()
```



In [ ]: