Improvements to Contract Valuation

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Goals of this Report

1. Calculate how contracts tend to increase or decrease from their original price before they are finalized

2. Discover which vendors sell contracts that tend to increase or decrease in price

3. Find which types of contracts are expected to increase or decrease, and by how much.

4. Make recommendations to the buyers and sellers of contracts based on my data-driven findings

How does this improve business decisions?

Reliable budgeting and planning

Example: If we know a long-term project is likely to cost less than it's initial contract price, then we do not have to wait until the final price is revised downwards before we use that additional cash elsewhere

Improved purchasing decisions based on more accurate prices

Example: If we know certain sellers underestimate their initial prices compared to other sellers, then we choose not to purchase from a seller we would have otherwise, knowing the initial price is "optimistic".

The opposite would be true for sellers whose contract values tend to revise downwards.

Why do contract values change?

- Unforeseen changes to scope of work required for the same good/service

  Example: construction dig project unexpectedly encounters large underground rocks

- Dissatisfaction with work already completed

- Agreement to change the quantity of services provided (extension or early termination)

Strategy and Dataset

Dataset

Asheville NC public--private contracts database.

Contains categories of contract types completed between private vendors and the municipal government of Asheville NC.

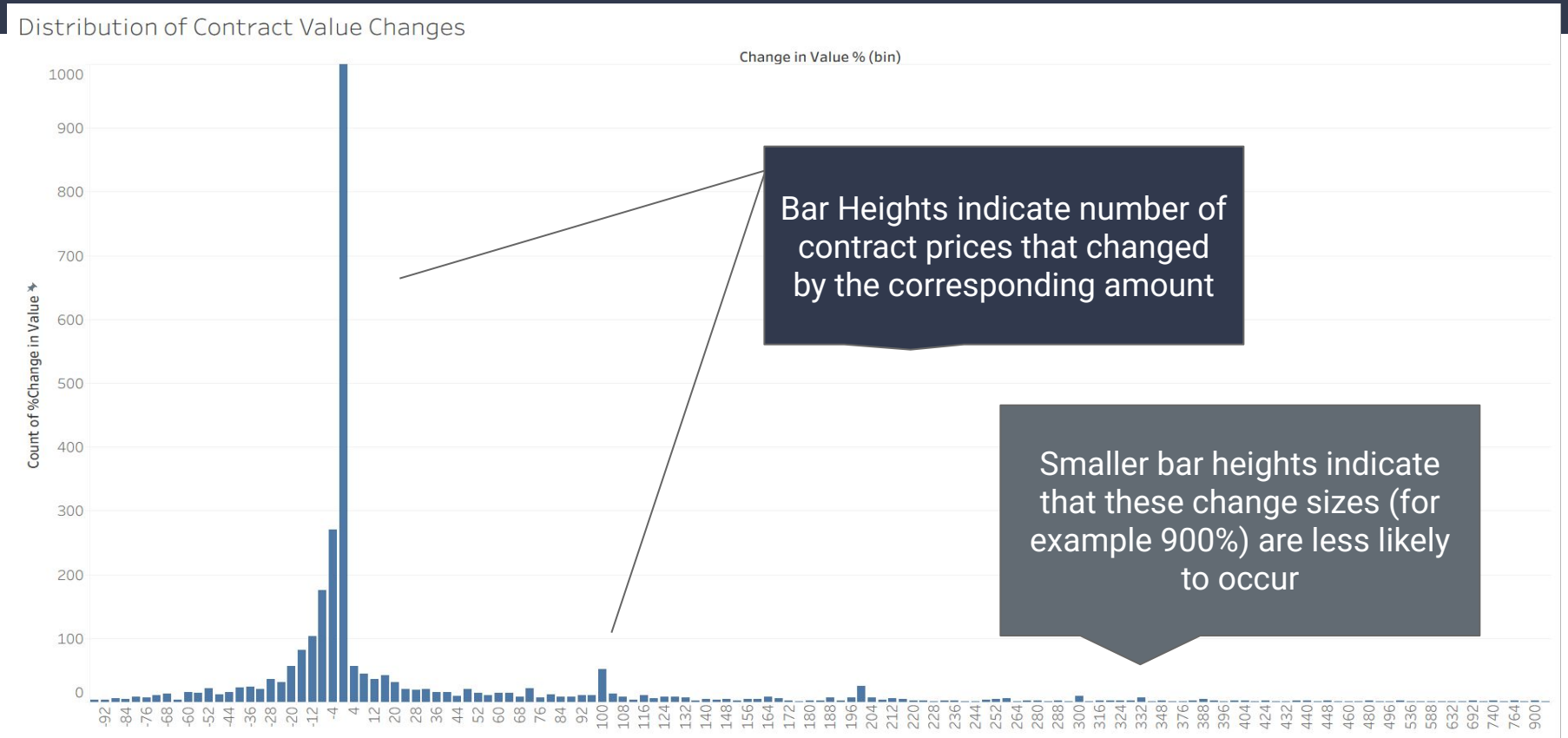
Includes original and final values of contracts, and date of final changes to the contract

Strategies

Compare the typical change in price (from original to final price) across different contract types.

Compare the typical changes in prices across vendors to inform contract purchasing decisions.

How to know when a seller over or underpricing contracts?



Sellers that over/underprice contracts

Technical Details and Example:

Vendor #4983 sold 10 contracts. The prices of 5 of these contracts all decreased by at least 17%

Using the distribution of contract value changes, I calculated the probability of a contract decreasing randomly by 17% or more

This probability is equal to the proportion of all contracts that decreased in price by at least 17% which is roughly 1 in 10

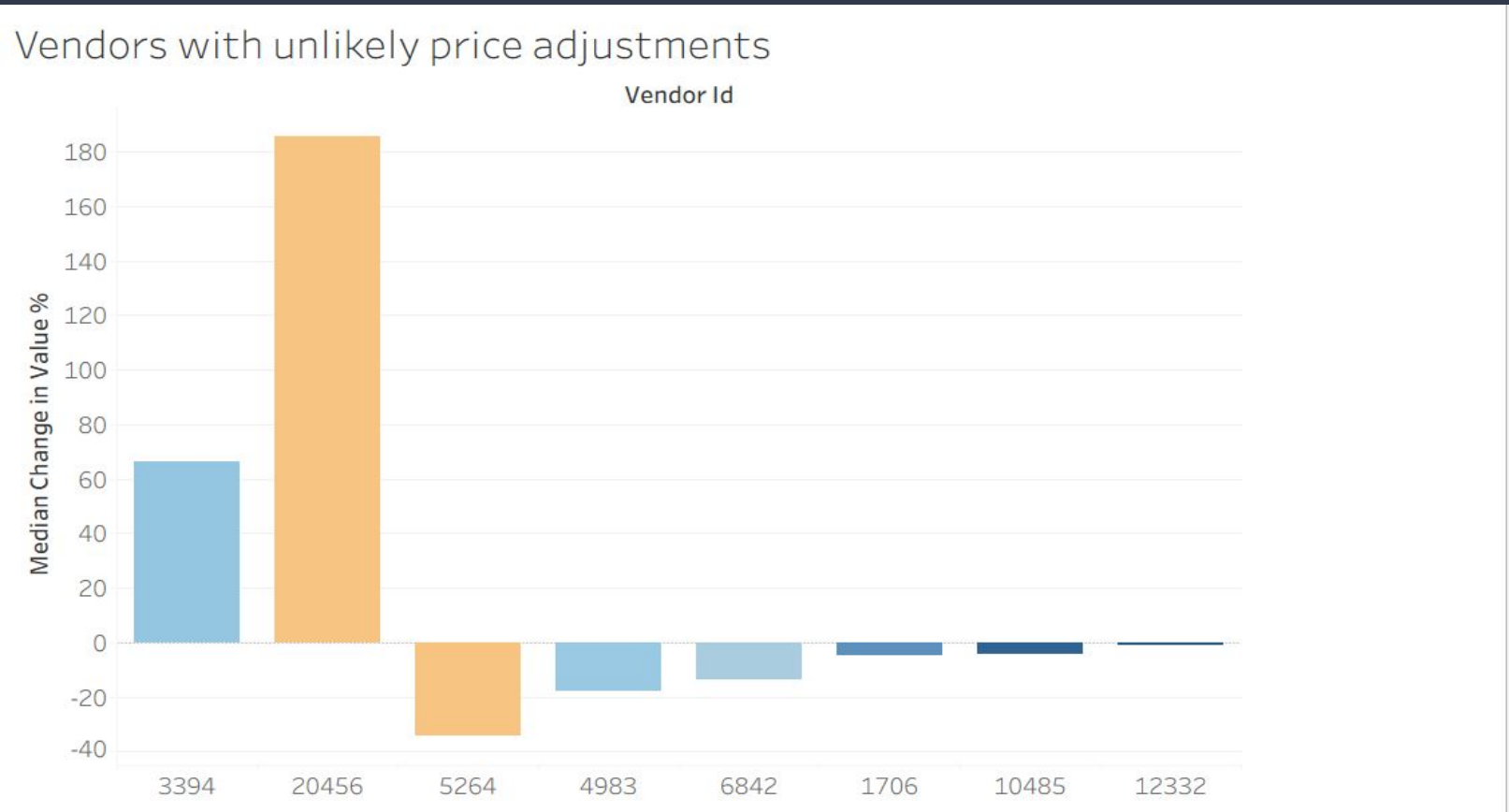
Now we can calculate the probability that a 1 in 10 event occurs 5 times out of 10 trials. As it did with this vendor (5 out of their 10 contracts decreased by at least 17%).

This probability is equal to 1 in 1000. So it is extremely unlikely that these overestimations of the original prices occurred by chance and were unrelated to the seller of the contract.

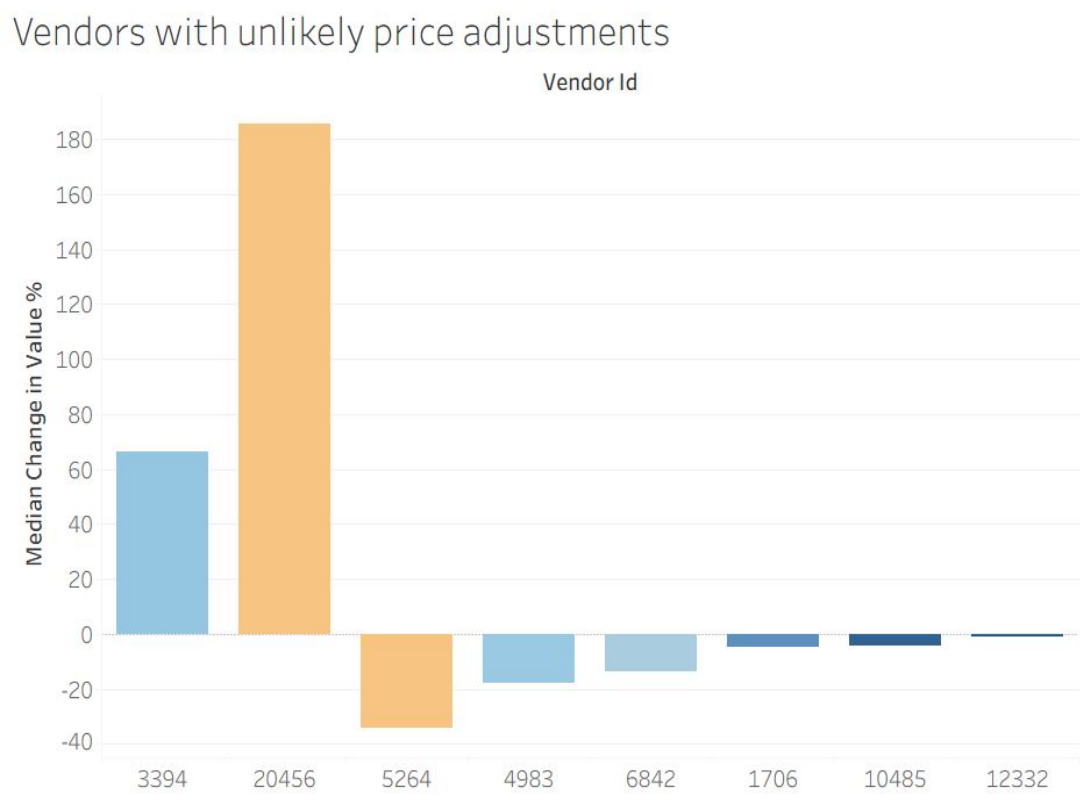
This was essentially the method I used on each vendor who sold at least 5 contracts to flag whether they non-randomly increased or decreased prices.

This method was necessary to use instead of typical two sample t-tests because of the non-normality of the data's distribution.

Results


Vendors with unlikely price adjustments
Vendor Id
Median Change in Value %
180
160
140
120
100
80
60
40
20
0
-20
-40
3394
20456
5264
4983
6842
1706
10485
12332
# of contracts sold
5
34

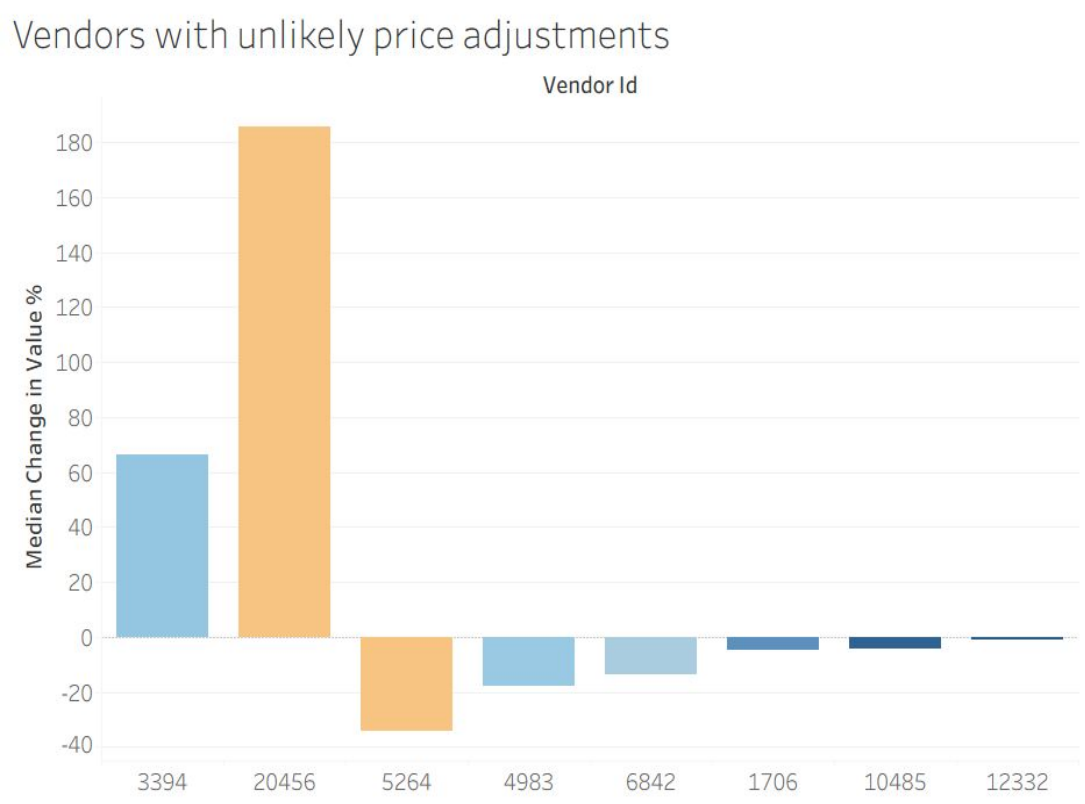
Recommendations



For sellers that increase contract value:

- Be wary of offers which appear cheap from these vendors as they may be underestimated
- May mean buyers are purchasing more work from the contractor, indicating satisfaction

Recommendations



For sellers that decrease contract value:

- They may have a flaw in their cost estimation that overprices their initial values (for complex projects)
  - Therefore: buy from these vendors when their initial price is equal or slightly higher than competitors

Problem

It is useful to know if vendors have a pricing bias because they misestimate the cost to complete the a task, or if they have a pricing bias because because the buyer and seller tend to agree to add or reduce the amount of work in the contract.

We will be less willing to buy from a seller whose prices increase because they estimate initial prices too low

We may be more willing to buy from a seller whose contracts increase because their partners are satisfied with their work and agree to extend the contract.

Solution

We can partially separate contract prices that change because of added or deducted objectives from those that change due to unforeseen costs by removing the extreme increases or decreases in price.

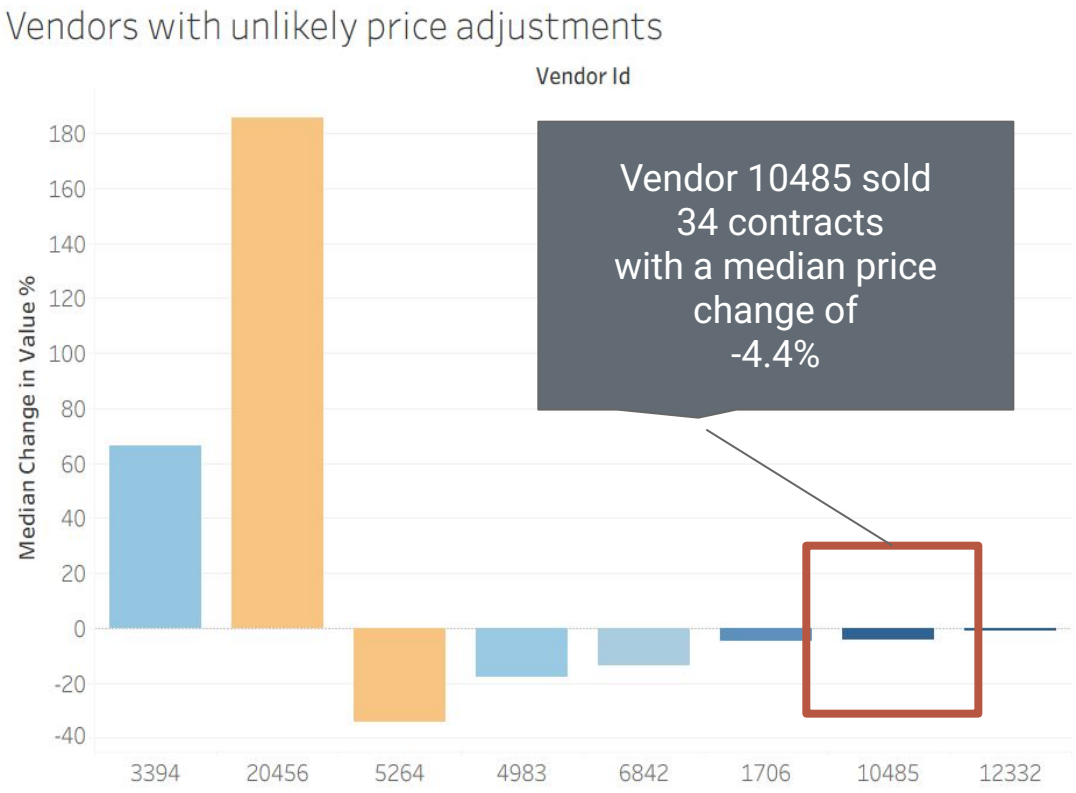
5% of the contracts in the dataset increased their original value by **3X** or more by the time they closed.

We assume that these extreme increases and decreases in value are only caused by large additions or reductions in the number of tasks agreed upon. Not unforeseen costs to the same objective.

These extreme changes reflect decisions of the buyers of contracts, not the sellers.

If we filter out these extreme values before running our test, we will be left with changes in price that have more to do with the contract vendors price estimation.

Recommendations



Result:
This new test flagged ONLY **vendor 10485** as having an improbable amount of reductions to contract prices

Because we limited the number of changes from added deliverables. I am confident that this reflects an overpricing of initial contract deliverables.

We should expect to pay 4.4% less than original price for contracts with vendor 10485

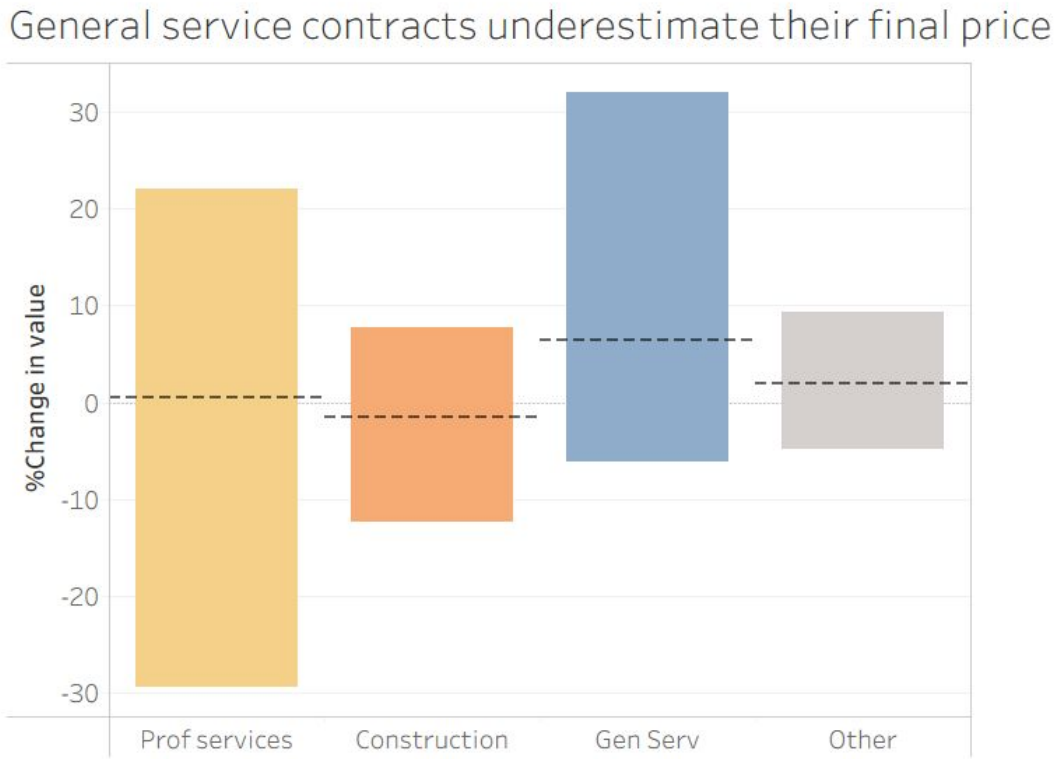
Expected price change for different contract types

This graph shows the average % change of contract values across contract types. (dashed lines)

Only the middle 70% of changes are used so the averages will not be inflated by extreme increases.

I assume that extreme changes to contract price that fall outside of this range reflect a voluntary decision taken by the buyer.

The size of the colored bars show the range of the middle 70% of changes.



General service contracts underestimate their final price

The average service contract's final price is 6.3% higher than its original price

Construction contracts are slightly overestimated, declining in price by 1.5% on average

Recommendations

Professional Services contracts should be accounted for at their original value since the average change is near zero, but the high variability of the final price means we should prepare for costs to end up being much higher or lower.

Construction contracts should be budgeted to cost 1.5% below their original value. Their low variability makes their price more reliable.

General Service contracts should be budgeted as costing 6.3% more than average, and we should expect high variability.

Summary

I recommend that vendors in the full list I made have their upwards or downwards biases factored in choosing who to buy services from.

I presented two sets of vendors. One with 8 vendors which all have a tendency for their contracts to rise or fall in price before they completed.

It is difficult to tell when these tendencies are due bias in estimating costs to complete the same objective, or when these tendencies were due to changes in the number of deliverables. However, the latter kind of addition is typically achieved with a new contract, rather than an amendment.

To account for this possibility, the second (conservative) test flagged only one vendor who is very likely to be overestimating costs for the same deliverables.

Summary

I recommend that budgets are adjusted according to the expected final values for contracts of the types presented in the table below

Contract Type	Average Price Change	Std. Deviation
Construction	-1.5%	3.8%
General Services	+6.3%	9.6%
Professional Services	0.0%	7.7%

Thank You for Your Time