

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

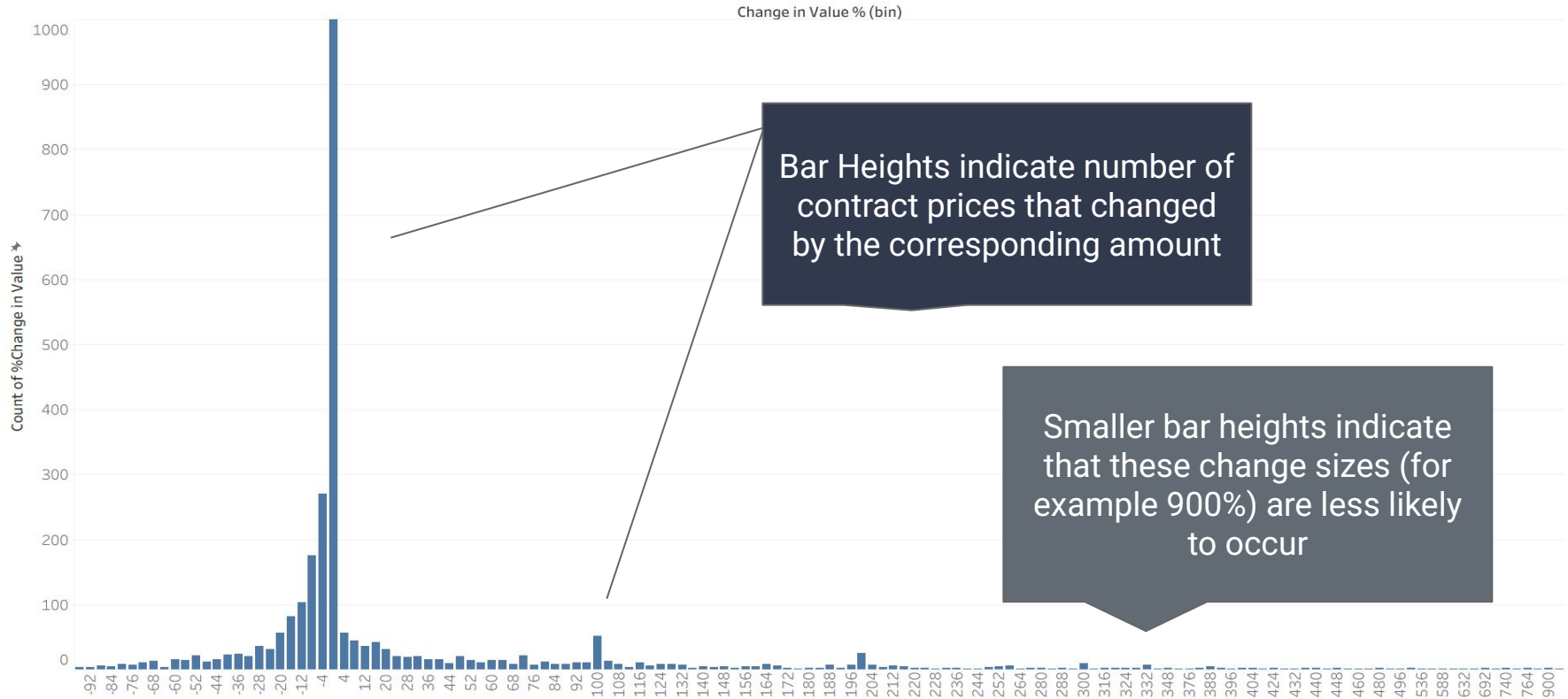
Strategies

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.

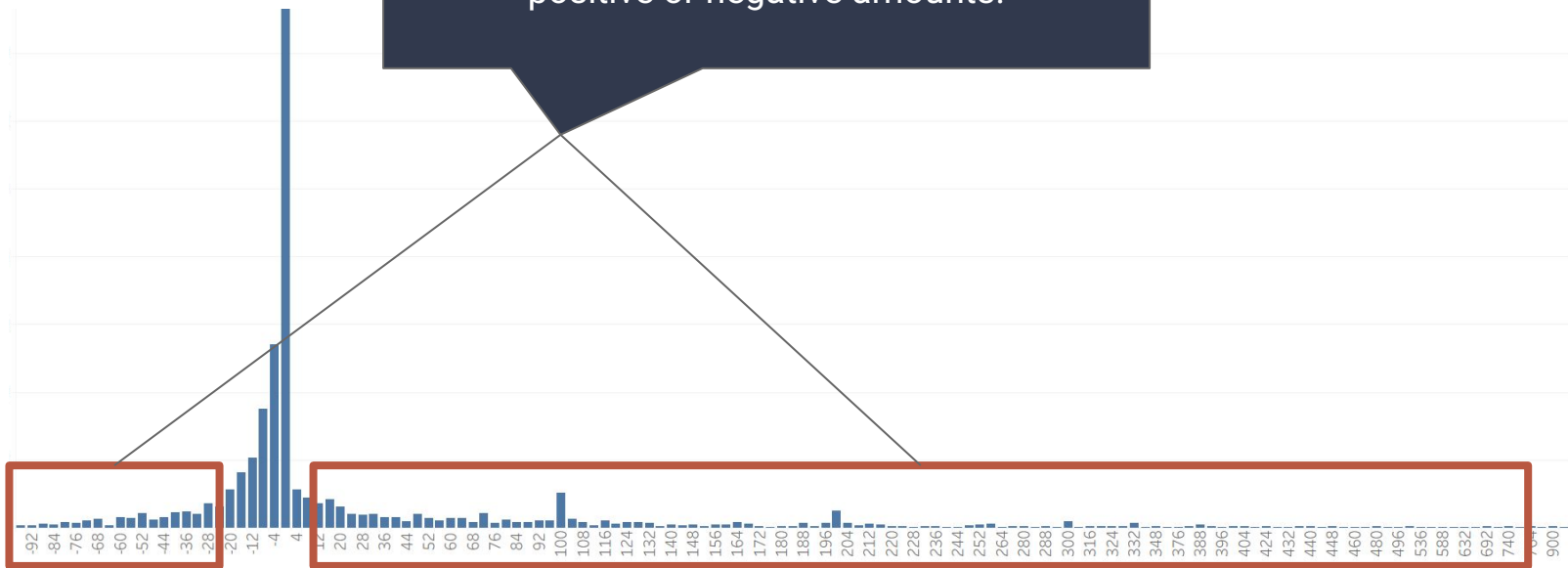
How to know when a seller over or underpricing contracts?

Distribution of Contract Value Changes



Sellers that over/underprice contracts

Some sellers have an unusual amount of contracts that all change by improbably positive or negative amounts.



Statistical Test

The most common test to see if two different groups have different central tendencies is the t-test for difference of means. If I used that test, I would compare the average price changes of each vendor and see if the average change was likely or unlikely to be different from zero.

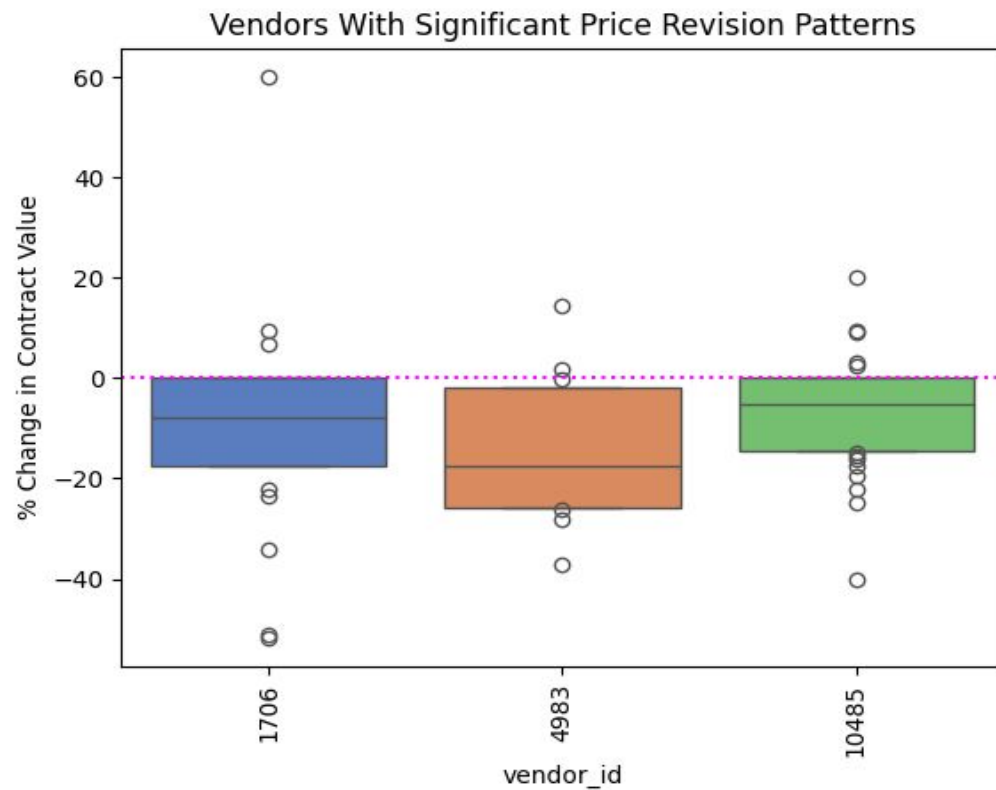
Because I am testing vendors that often have few data points, and, at the same time, the %price change data are non-normal (highly skewed and inflated number of zeroes), I decided it would be better to use a different test that works better with this messier data.

I chose to use the Mann-Whitney U test, which is analogous to the t-test and works better for non-normal data. The U-test accounts for the high number of large price increases by measuring the ranks of each datapoint between vendors, rather than the raw value of the price change. This made my flagging process more robust to false positives and negatives.

I also accounted for the probability of false discovery (or p-hacking) due to the fact that I tested 76 vendors.

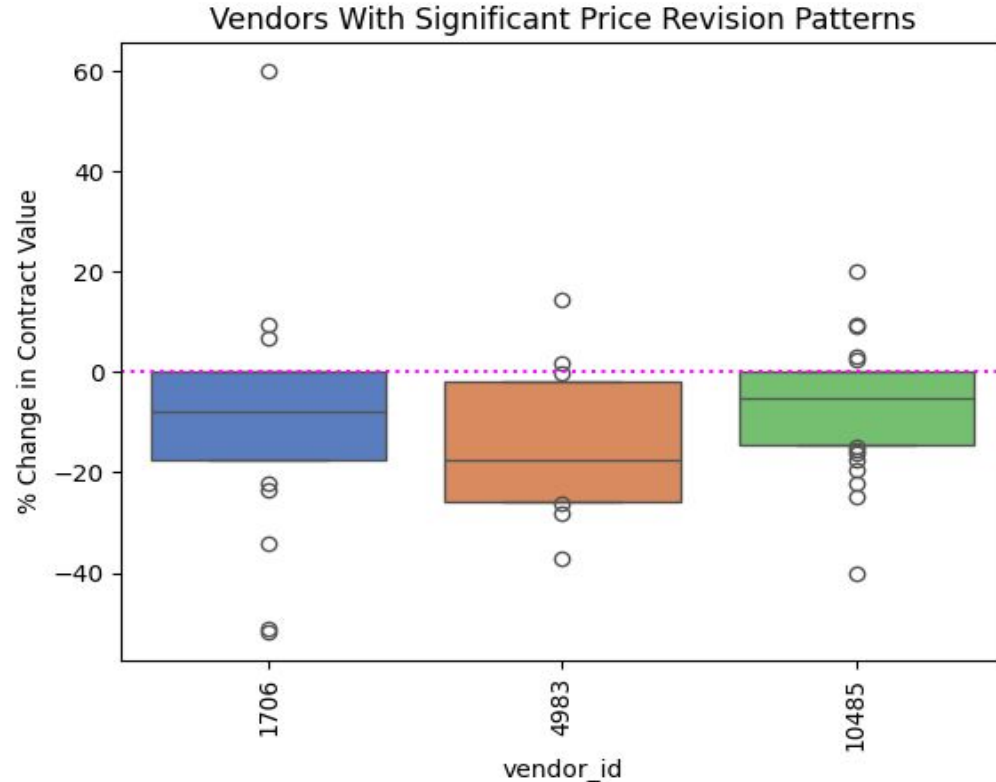
More details about the statistical methods are available in [my python notebook](#)

Results



Vendor ID	Count	Average Price Change	Median Price Change
1706	19	-8.91%	-7.89
4983	10	-14.29%	-17.65
10485	30	-6.85%	-5.17

All flagged vendors had tendencies to revise prices lower



Insights and Recommendations

These vendors may have a flaw in their cost estimation that causes their initial estimates to be too high

Action: buy from these vendors when their initial price is equal to, or slightly higher than competitors

They may be intentionally overpricing their initial estimates to increase revenue

Action: scrutinize their cost estimates when buying from them, in case they are inflated.

Recommendations (continued)

Vendor Name	Average Price Change	Median Price Change	Confidence Level
McGill Associates	-8.91%	-7.89	85%
Environmental Testing Solution	-14.29%	-17.65	85%
Patton Construction Group	-6.85%	-5.17	95%

I recommend that buyers use the expected final price of the service when comparing prices from these vendors to their competitors. This expected price could be calculated with this formula:

$$(1 + \text{average proportion price change of vendor}) \times \text{original price}$$

(The proportion price change = %change/100)

Expected price change for different contract types

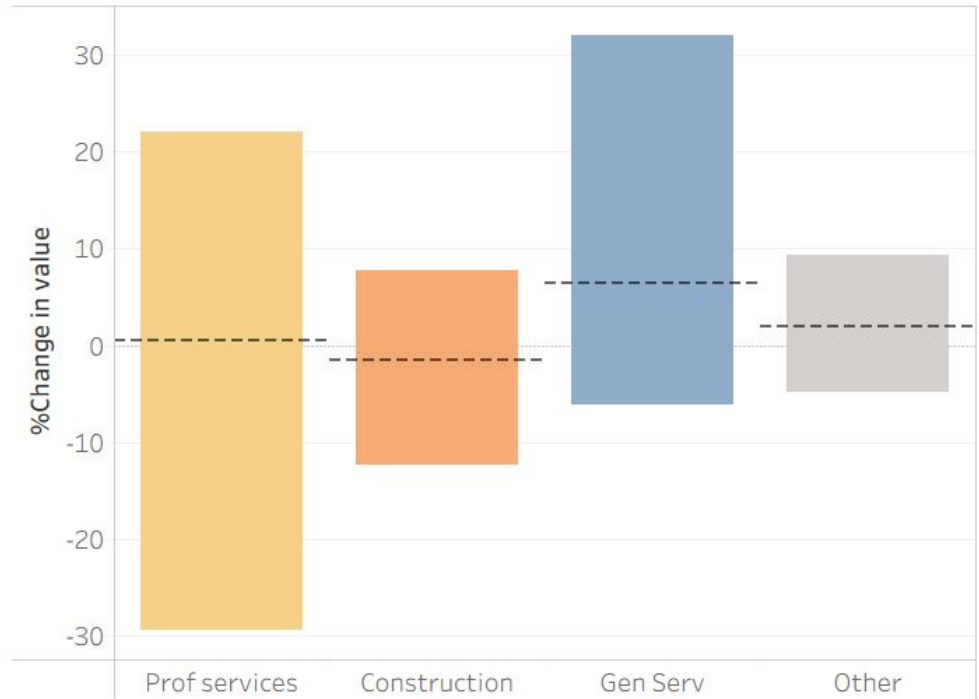
This graph shows the average % change of contract values across contract types. (dashed lines)

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

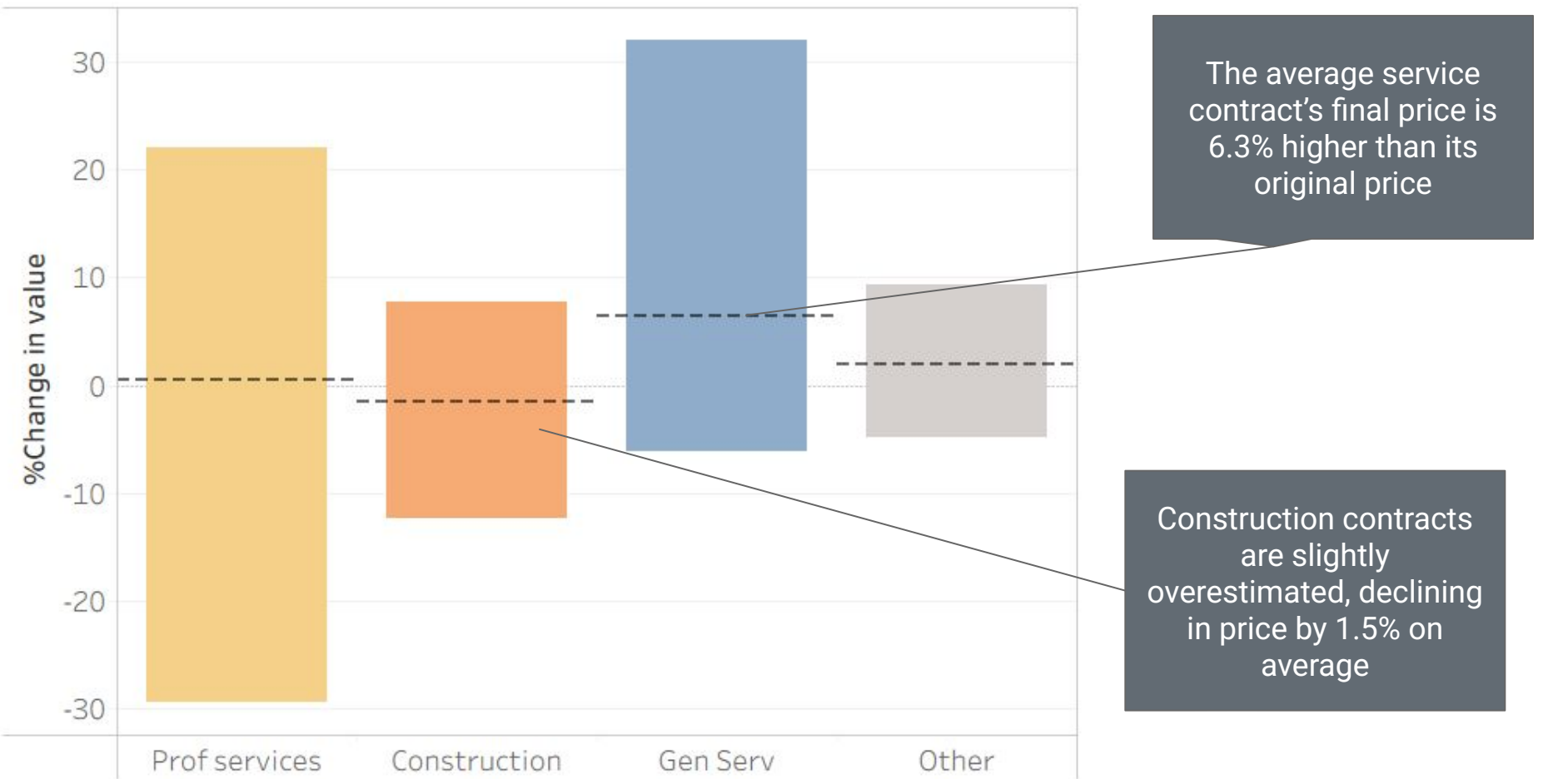
I assume that extreme changes to contract price that fall outside of this range reflect a voluntary decision taken by the buyer.

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

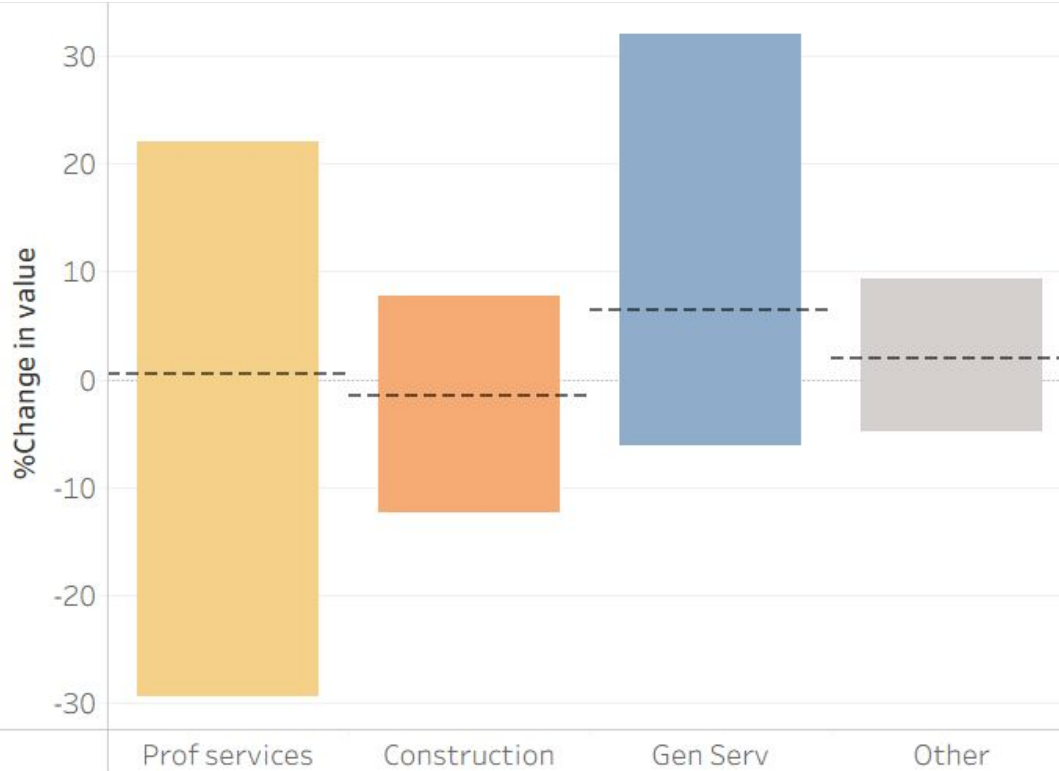
General service contracts underestimate their final price



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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 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%

Summary

I recommend that when buying from these vendors:

1. Their original price is adjusted lower to reflect the expectation that it will lower by the average %change
2. Their work and estimates are examined carefully to ensure the price is not being inflated

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Thank You for Your Time