An analysis of McGill budget book variances (Contract Services, Professional Fees, salaries, grants, tuition & fees)

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Context, data sources, analyses

Context:

- ▶ The FY26 academic salary budget reveals a concerning trajectory: FY22: 4.3%, FY23: 4.9%, FY24: 5.2%, FY25: 2.9%, FY26: 1.3%. How reliable is this budget estimate likely to be in terms of the FY26 forecast and FY26 actuals (if actuals are going to be reported in 2026)?

- ▶ How might the FY26 academic salary budget impact actual academic salary increases in the face of changing academic staff head counts, hiring freezes, replacement of tenure-track academic staff with an increasing number of contract academic staff, etc?

- ▶ Actual expenditures and revenues have not been reported on a systematic annual basis since FY2018. Are the annual "forecasts" reliable proxies for actuals? Are variances in forecasts/actuals correlated with their budgeted counterparts?

Data sources: McGill University Budget Books for FY2016-FY2026 (for the unrestricted fund).

Analyses:

1. Cumulative sums (over years), differenced (forming the cumulative variances), and then pro-rated/reduced/normalized by dividing by the number of years in the sum (M\$/year, places a higher weight on more recent years due to inflationary growth).

2. Paired-difference: $H_0 : \mu_D = 0$, $H_1 : \mu_D > 0 | \mu_D < 0$.

3. Two-sample difference (pooled variances): $H_0 : \mu_1 = \mu_2$, $H_1 : \mu_1 > \mu_2 | \mu_1 < \mu_2$.

4. Multiple linear regression of categorical random variables (variances in reported budget-book line items).

Actuals available for FY2014-18,24. No budget book for FY2020-2021 (no FY21 forecasts, no FY21 budgets).

Contract Services were not forecasted for FY2015.

Cumulative actual to forecasted variances

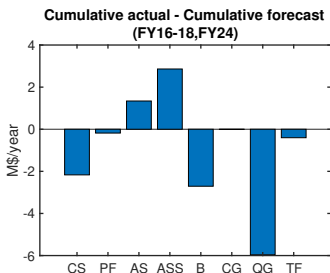Are "forecasts" accurate representations of "actuals"?

Figure 1: Cumulative expenses and revenues (on an annual basis): Contract Services (CS), Professional Fees (PF), Academic Salaries (AS), Admin. and Support Salaries (ASS), Benefits (B), Canada Grants (CG), Quebec Grants (QG), Tuition and Fees (TF).

Actual and forecasted counterparts available for FY16-18,24. Amounts summed, compared, pro-rated over 4 years.

Over the 4 years: forecasted Contract Services exceed actual amounts by about M\$8; actual Admin. and Support Salaries exceed forecasted amounts by about M\$12; forecasted Benefits exceed actual amounts by about M\$12; forecasted Quebec Grants exceed actual amounts by about M\$28.

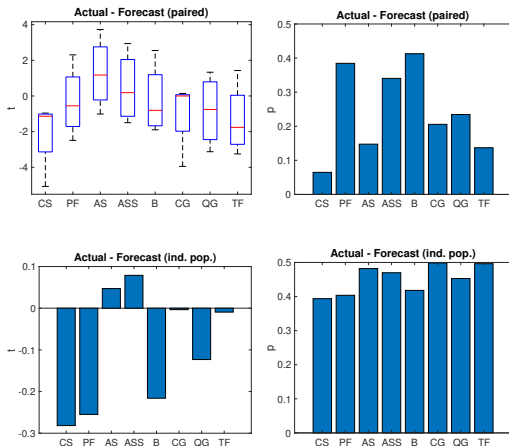# Comparing actuals with forecasts (statistical analyses)

Figure 2: Contract Services (CS), Professional Fees (PF), Academic Salaries (AS), Admin. and Support Salaries (ASS), Benefits (B), Canada Grants (CG), Quebec Grants (QG), Tuition and Fees (TF).

Evidence to reject H_0 for CS, i.e., evidence of forecasts of Contract Services expenses being larger than actuals is evident only when examining the paired differences.

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Cumulative forecasted to budgeted variances

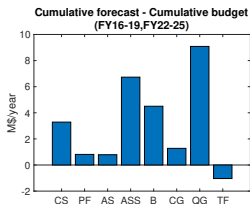How do "forecasts" compare with "budgets"?

Figure 3: Cumulative expenses and revenues (annual basis), pro-rated: Contract Services (CS), Professional Fees (PF), Academic Salaries (AS), Admin. and Support Salaries (ASS), Benefits (B), Canada Grants (CG), Quebec Grants (QG), Tuition and Fees (TF).

Forecasted and budgeted counterparts available for FY16-19,FY22-25. Amounts summed, compared, pro-rated over 8 years.

Forecasted expenses and revenues almost exclusively exceed, by significant amounts, their budgeted counterparts. Over the 8 years: forecasted Admin. and Support Salaries exceed budgeted amounts by about M$56; forecasted benefits exceed budgeted amounts by about M$36; forecasted Quebec Grants exceed budgeted amounts by about M$72.

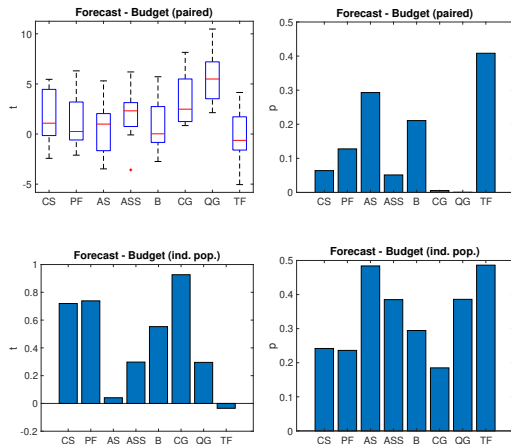# Comparing forecasts to budgets (statistical analyses)

Figure 4: Contract Services (CS), Professional Fees (PF), Academic Salaries (AS), Admin. and Support Salaries (ASS), Benefits (B), Canada Grants (CG), Quebec Grants (QG), Tuition and Fees (TF).

Evidence to reject H_0 for CS, ASS, CG, QG, i.e., forecasts (often used as proxies for actuals) for these expenses and revenues are larger than budgeted, but only when examining the paired differences.

Cumulative actual to budgeted variances

How do "actuals" compare with "budgets"?

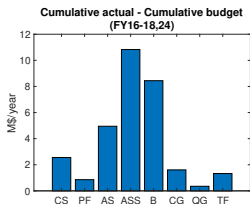**Cumulative actual - Cumulative budget (FY16-18,24)**

Figure 5: Cumulative expenses and revenues (annual basis): Contract Services (CS), Professional Fees (PF), Academic Salaries (AS), Admin. and Support Salaries (ASS), Benefits (B), Canada Grants (CG), Quebec Grants (QG), Tuition and Fees (TF).

Actual and budgeted counterparts available for FY16-18,24. Amounts summed, compared, pro-rated over 4 years.

Actual expenses significantly exceeded budgeted counterparts. Over the 4 years: actual Academic Salaries exceed budgeted amounts by about M$20; actual Admin. and Support Salaries exceed budgeted amounts by about M$44; actual benefits exceed budgeted amounts by about M$34.

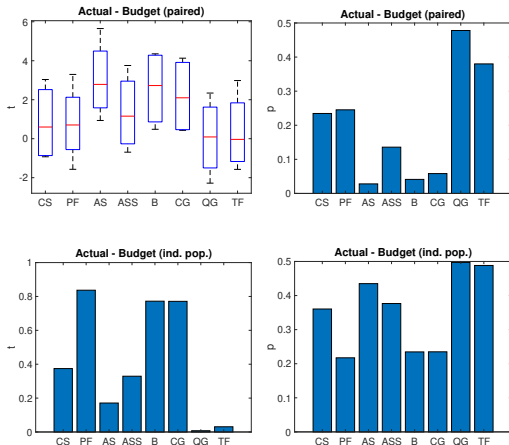# Comparing actuals to budgets (statistical analyses)

Figure 6: Contract Services (CS), Professional Fees (PF), Academic Salaries (AS), Admin. and Support Salaries (ASS), Benefits (B), Canada Grants (CG), Quebec Grants (QG), Tuition and Fees (TF).

Evidence to reject H_0 for AS, B, CG, i.e., actuals for these expenses and revenues are larger than budgeted, but only when examining the paired differences.

Multiple linear regression with categorical variables

Regression analysis undertaken with the 8 categorical variables: expenses CS, ... B, & revenues CG, QG, TF. Paired differences are scaled with their respective sample standard deviations:

$$d_{ij} = (x_i - x_j)/s_{d,ij},$$

so that each normalized random variable d_{ij} has a same variance (for an assumed normal distribution).

This analysis is considered more reliable than the others, since it combines degrees of freedom from all the data sources, also providing some practical predictive formulas and metrics....

Multiple linear regression results I

Neglecting those regression coefficients with p-values > 0.05, the significant regressors give models:

- ▶ Actuals relative to forecasts:

$$\bar{d}_{af} = -1.04 + 1.67\mathsf{AS},$$

  respective p-values 0.0487, 0.0265;

- ▶ Forecasts relative to budgets:

$$\bar{d}_{fb} = 1.38\mathsf{QG},$$

  p-value 0.0078;

- ▶ Actuals relative to budgets (all p-values > 0.05):

$$\bar{d}_{ab} = 0.$$

Multiple linear regression results II, example application

Table 1: Population standard deviations s_{ij} (M\$) used to normalize expense and revenue differences/variances. $\sqrt{\text{MSE}}$ is the root-mean-squared-error for each linear regression model.

-	$\sqrt{\text{MSE}}$	CS	PF	AS	ASS	B	CG	QG	TF
s_{af}	1.04	2.09	1.13	2.12	12.6	22.5	0.014	14.4	0.603
s_{fb}	1.86	5.38	1.85	3.90	10.1	14.9	1.05	4.56	12.2
s_{ab}	1.09	6.19	2.18	3.26	16.1	6.56	1.47	11.7	7.9

Example: Actual academic salary expenses deviate from their respective forecast with a standard deviation of M\$2.12, academic salary forecasts deviate from budgets with a standard deviation of M\$3.90, and actual academic salary expenses deviate from budgets with a standard deviation of M\$3.26. Note that the only significant average deviation, according to the linear regression analysis above, is of the actuals to forecast:

$$\bar{d}_{af} \equiv \frac{\text{AS}_a - \text{AS}_f}{s_{AS}} = -1.04 + 1.67 \Rightarrow \text{AS}_a - \text{AS}_f = 0.63 \times 2.12 = \text{M\$}1.3,$$

i.e., the actual academic expenses are, on average, greater than the respective budget by M\$1.3, about 0.4% of the actual academic salary costs for FY24 (FY24: budget M\$338, actual M\$340, forecast M\$341).

Caution: This analysis assumes, perhaps incorrectly, that the 'variances' in each budget line item are independent of time; these may scale/grow with the magnitude of the respective budget line item.

Model predictions

Academic Salary actuals differ from forecasts by an amount

$$\text{AS}_a - \text{AS}_f = (-1.04 + 1.67) \times 2.12 = \text{M\$}1.3.$$

Contract Services actuals differ from forecasts by an amount

$$\text{CS}_a - \text{CS}_f = -1.04 \times 2.09 = -\text{M\$}2.2.$$

Quebec Grants forecasts differ from budgets by an amount

$$\text{QG}_f - \text{QG}_b = 1.38 \times 4.56 = \text{M\$}6.3.$$

On average, actuals differ from forecasts by a net amount: $1.3 - 2.2 = -\text{M\$}0.9.$

Academic staff headcounts

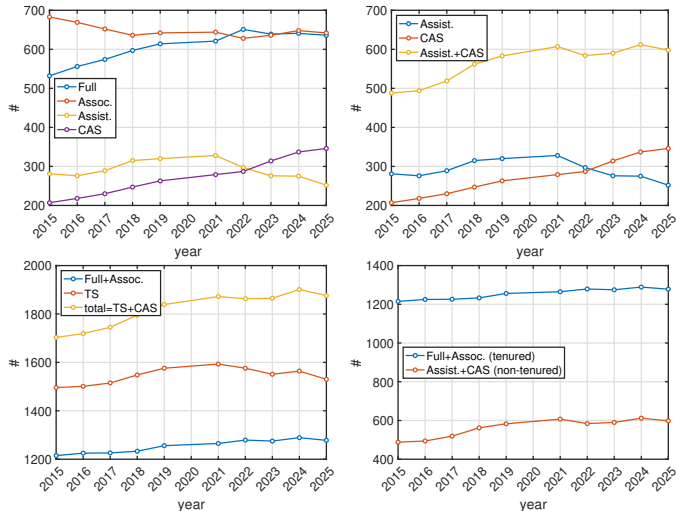Sources: Salary policy documents.

Figure 7: Academic staff headcounts (top-left) and various groupings.

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 1  % FY | Contract Services | Professional Fees | Academic Salaries | Admin Support Salaries | Benefits...
 2  %     | Canada Grants | Quebec Grants | Tuition Fees | forecast/actual/budget=0/1/2
 3  % ======================= forecasts  =======================
 4  2015 nan 11641 225831 216530 72523 25084 347950 266021 0; % forecasts, FY15/16 budget book, appendix 2
 5  2016 17300 10467 247544 218946 74575 25832 327348 275302 0; % forecasts, FY16/17 budget book, appendix 2
 6  2017 15557 9813 261996 207447 103914 28864 336418 294969 0; % forecasts, FY17/18 budget book, appendix 2
 7  2018 15184 11470 274180 228739 117136 28422 335985 319243 0; % forecasts, FY18/19 budget book, appendix 2
 8  2019 21735 9110 285390 242040 108010 30970 360090 350000 0; % forecasts, FY19/20 budget book, appendix 3
 9  2021 26856 7622 298951 253874 110755 31085 370794 382381 0; % forecasts, FY21/22 budget book, appendix 2
10  2022 23634 11605 310918 266937 108433 31799 398223 389772 0; % forecasts, FY22/23 budget book, appendix 2
11  2023 25309 15024 321229 286408 113077 32931 429971 388819 0; % forecasts, FY23/24 budget book, appendix 2
12  2024 36900 11709 340610 322630 121225 32425 473500 411917 0; % forecasts, FY24, FY24/25 planning budget^*
13  2025 37131 15765 350509 329376 124693 32650 478657 430157 0; % forecasts, FY24/25 budget book, appendix 1
14  2025 37131 15765 350509 329376 124693 32650 478657 430157 0; % forecast FY25, 25/26 planning budget
15  % ======================= actuals  =======================
16  2014 12996 9362 224018 212640 96514 24840 352738 245241 1; % actuals, FY16/17 budget book, appendix 2
17  2015 13920 10661 237332 202061 101197 25788 341640 258489 1; % actuals, FY16/17 budget book, appendix 2
18  2016 12004 9059 249433 209495 103303 25832 336956 274322 1; % actuals, FY17/18 budget book, appendix 2
19  2017 14303 11118 265944 214705 87584 28865 313869 294314 1; % actuals, FY18/19 budget book, appendix 2
20  2018 14066 10944 274780 247288 95759 28422 337869 314319 1; % actuals, FY19/20 budget book, appendix 3
21  2024 35897 11611 339538 317721 119375 32397 460766 411511 1; % actuals, FY23/24 budget book, appendix 1^*
22  % ======================= budgets  =======================
23  2016 nan 10775 240228 208171 89018 25518 323257 280568 2; % budgets, FY15/16 budget book, appendix 2
24  2017 17173 10075 260503 220277 73765 25832 327214 291561 2; % budgets, FY17/18 budget book, appendix 2
25  2018 7875 7342 271147 217038 94177 25708 332544 307836 2; % budgets, FY17/18 budget book, appendix 2
26  2019 12076 10491 287422 234347 112981 30438 350845 332138 2; % budgets, FY18/19 budget book, appendix 2
27  2020 19516 9019 294096 251084 110040 32000 359822 358037 2; % budgets, FY19/20 budget book, appendix 3
28  2022 28250 12073 311671 261244 112275 31085 381314 398301 2; % budgets, FY21/22 budget book, appendix 2
29  2023 24002 12285 326525 277500 112678 31799 415970 410568 2; % budgets, FY22/23 budget book, appendix 2
30  2024 26506 11116 338016 300414 115300 32030 464981 414544 2; % budgets, FY23/24 budget book, appendix 2
31  2025 36092 14318 349266 329690 124855 31276 471382 432967 2; % budgets, FY25/26 budget book, appendix 1
32  2026 36045 14010 355081 332994 124658 32325 483938 419391 2; % budgets, FY25/26 budget book, appendix 2
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% A   | B  | C  | D  | E | F | G | H | year | TS | CAS | ATB | total merit | cat 1, 2, 3, 4
636 642 252 154 42 8 60 82 2025  1530  346 1.00 4.5 6.0 4.3 2.65 1.5
641 648 275 160 35 8 55 79 2024  1564  337 1.00 4.5 6.0 4.3 2.65 1.5
639 636 276 153 30 7 55 69 2023  1551  314 1.00 4.5 6.0 4.3 2.65 1.5
651 628 297 135 28 6 47 71 2022  1576  287 1.35 4.1 4.75 3.05 1.8 1.0
621 644 328 129 28 4 44 74 2021  1593  279 1.00 3.75 4.00 2.77 1.7 1.00
614 642 320 126 24 2 39 72 2019  1576  263 0.75 2.15 2.015 1.625 1.235 0.845
597 636 315 118 19 2 37 71 2018  1548  247 0.75 2.5 2.65 2.0  1.35 0.7
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532 683 281 118 13 2 19 55 2015  1496  207 0.75 4.95 7.150 5.30 3.45 1.60
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