

APR Insights 2023

Rio Tinto - HR Data Science

2023-10-10

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## Introduction

### Identifying the impact people-related factors have on productivity.

A multiple linear regression analysis of HR metrics onto the Copper Equivalence (CuEqk) metric at a full equity basis and in kilo tonnes unit.

Notes on analysis:

- Data is sourced from the MPR (Monthly Performance Report) dashboard and is grouped at a monthly frequency, and spans 54 months from December 2019 to October 2023.
- Overall, these models suggest that different predictor variables have different effects on the Copper Equivalent across APR Product Group (LV2) splits.
- The focus of the analysis was on HR metrics - excluding time related and other non HR variables.
- This is not a time series analysis of CuEqk for predictive purposes - other less interpretable but more accurate non-linear methods can be used.
- Three visualisations accompany each model:
  1. Predicted versus Actuals plot: a time series plot of the predicted CuEqk values along side the actual historical values. Useful for seeing how well the model performs over time.
  2. Model Feature History plot: a time series plot of the historical values for all variables used in the model. Useful for investigating how these features change over time and impact fitted values.
  3. Model Feature Impacts plot: a linear plot for each model variable showing their historical range and the impact their estimated model coefficient will have on CuEqk with all other variables being held at their mean. Useful for visualising the range of historical feature values and their modelled impact on CuEqk.
- It is important to note, that other non-HR factors not included in the models may also contribute to the Copper Equivalence metric, and that causality cannot be inferred from a regression analysis alone. See next point on confounding variables.
- The nature of the problem (relating HR metrics to productivity metrics) means we are ignoring potentially crucial confounding variables that may more directly impact CuEqk: i.e. weather events, shut downs, large maintenance events, safety incidents, seasonal cycles, etc. <sup>1</sup>
- The regression model assumptions were reasonably well met in this case, and the adjusted R square scores, mean absolute errors, and mean absolute percentage errors could be considered “good” in the context of the problem.

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<sup>1</sup>As an example of a confounding variable: consider modelling the relationship between shark attack incidents and ice cream sales. Here a confounding variable could be weather or a hot summers day.

## Summary of Results

### Common Positive Effects Across Groups:

**Indigenous Employment:** Higher Indigenous employment percentages, both among employees and contractors, positively impact CuEqk across various sectors (All Rio Tinto, Aluminium, Copper, and Minerals). This suggests a potential correlation between Indigenous employment initiatives and overall productivity.

**Gender Diversity (Specific Cases):** In Copper and Minerals, an increase in the number of women in contractor headcount has a positive effect.

Gender diversity percent of employees in Aluminium also had a positive effect, though it had a negative effect in Copper.

**Absence Management:** Planned absence rate percent of employees positively influences CuEqk in the Minerals sector. Similarly, unplanned absence rate of employees has a positive relationship with CuEqk in Iron Ore. This underscores the importance of absence policies and their impact on productivity.

**People Survey:** The average score of the *Recommended* people survey question had a strong positive impact on CuEqk.

### Other Common Effects Across Groups:

#### Time in Rio, Band, and Position:

**For All Rio Tinto:** Time in Rio for employees, and time in band for contractors has positive impact on CuEqk from the all Rio Tinto perspective. However, time in band for employees had the opposite effect for all of Rio. This could indicate that while general experience is beneficial, stagnation within the same band for employees might hinder productivity.

**For Aluminium:** Time in band and position has a positive effect for employees and a negative one for contractors. This implies that it's beneficial to retain employees in their roles and bands, as they become more productive over time. On the other hand, for contractors, it might be more productive to have them move between roles or bands.

**For Iron Ore:** Time in band and position have negative effects for employees and contractors. This suggests that stagnation in roles or bands is detrimental to productivity, and it might be more advantageous to encourage mobility or change.

**For Copper:** Time in Rio Tinto has a positive effect on CuEqk for contractors and a negative effect for employees. However, the percent of employees in their band for less than two years has a positive effect on CuEqk. This suggests a mix of experienced contractors and relatively new employees.

**Turnover Impact:** High turnover rates for contractors (RT Terminations) across all Rio, and both employees (Employee Initiated Terminations) and contractors (RT Terminations) in Iron Ore have negative impact on CuEqk. Turnover (Employee Initiated Terminations) percent for employees has a positive impact on CuEqk in Aluminium.

### Overall Implications:

**Holistic Employee Engagement:** Enhancing Indigenous employment initiatives, promoting stable tenure, and managing turnover rates could be pivotal strategies for improving people productivity across various product groups.

**Contextual Diversity Strategies:** Tailoring diversity initiatives (gender and Indigenous employment) to each sector might yield more effective results. Understanding sector-specific challenges and opportunities is crucial for targeted interventions.

**Retention and Absence Management:** Strategies that focus on retaining experienced staff and effectively manage absences (especially planned ones) could yield wide people productivity improvements.

**Note:** While these observations highlight correlations, further in-depth analysis and contextual understanding are necessary to establish causation and formulate actionable strategies.

## All Rio Tinto

- The model for all Rio uses data for all Level Two (Product Group) entities. The model contains more data but cannot capture differences for individual Product Groups.

**Adjusted R-squared** = 0.996

**Mean Absolute Error** = 41.7 kilo tonnes CuEqk

**Mean Absolute Percentage Error** = 2.85 percent

**n\_samples** = 104

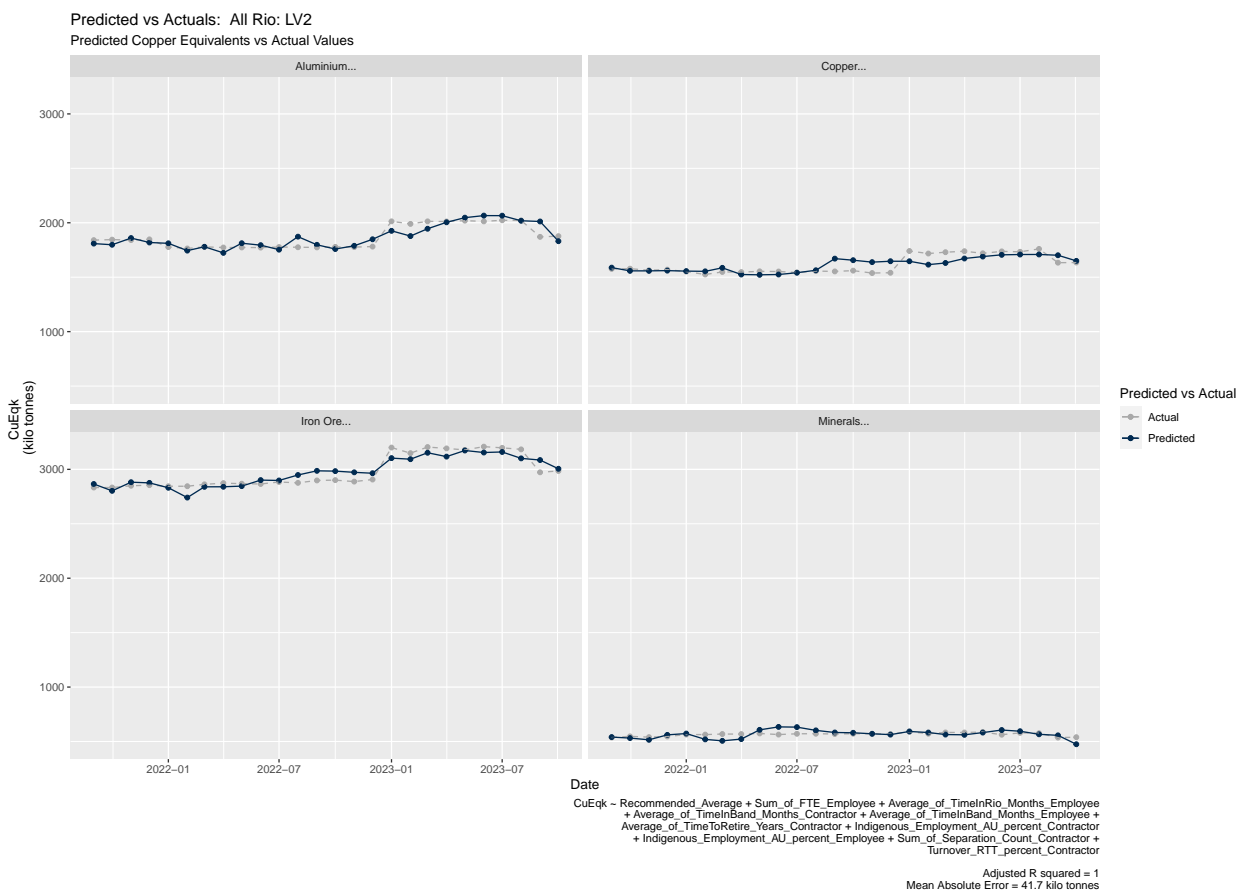
**Model Coefficients:**

Coefficient	Estimate	p_value
Recommended_Average	19.26	0
Sum_of_FTE_Employee	0.07	0
Average_of_TimeInRio_Months_Employee	7.32	0
Average_of_TimeInBand_Months_Contractor	13.43	0
Average_of_TimeInBand_Months_Employee	-39.97	0
Average_of_TimeToRetire_Years_Contractor	-1.62	0
Indigenous_Employment_AU_percent_Contractor	17.80	0
Indigenous_Employment_AU_percent_Employee	186.29	0
Sum_of_Separation_Count_Contractor	1.18	0
Turnover_RTT_percent_Contractor	-130.08	0

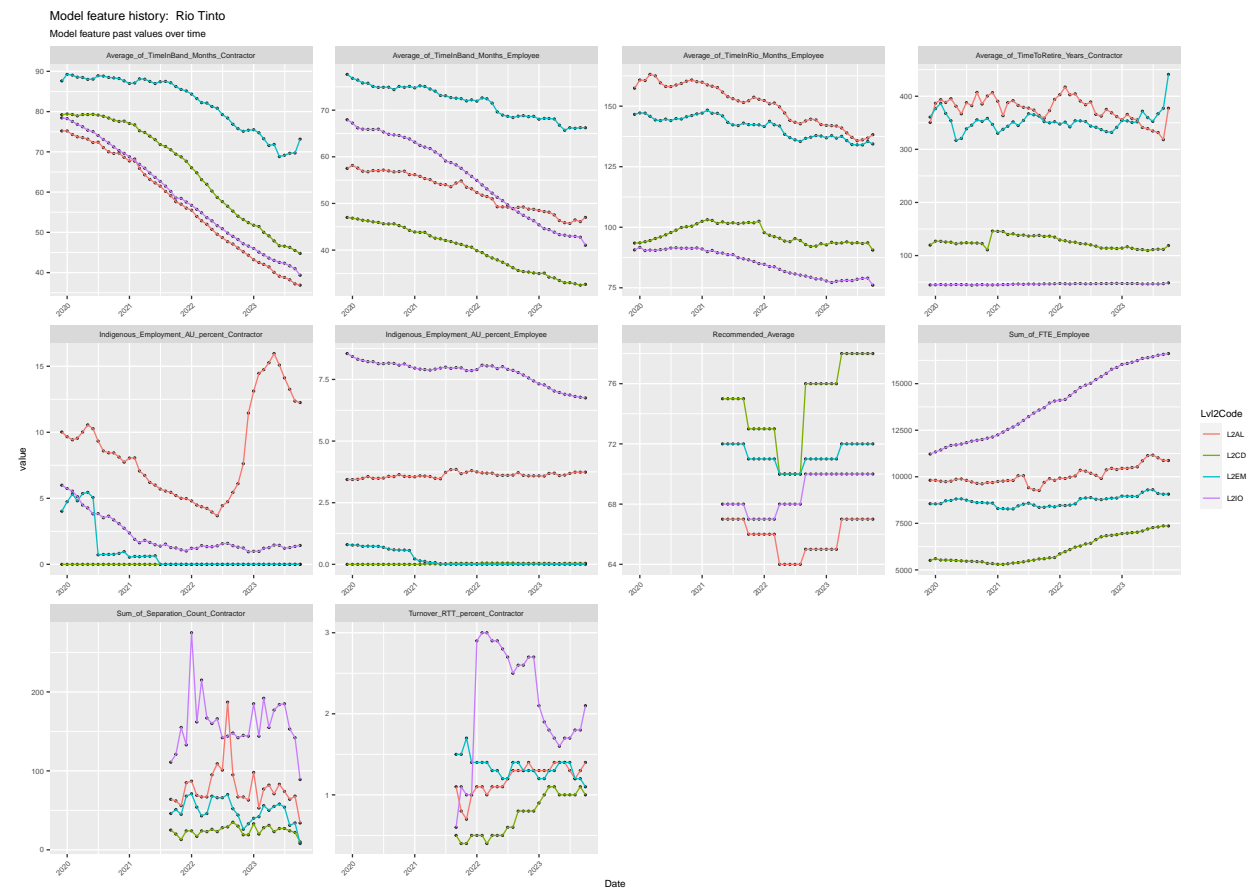
From the table above we see that:<sup>2</sup>

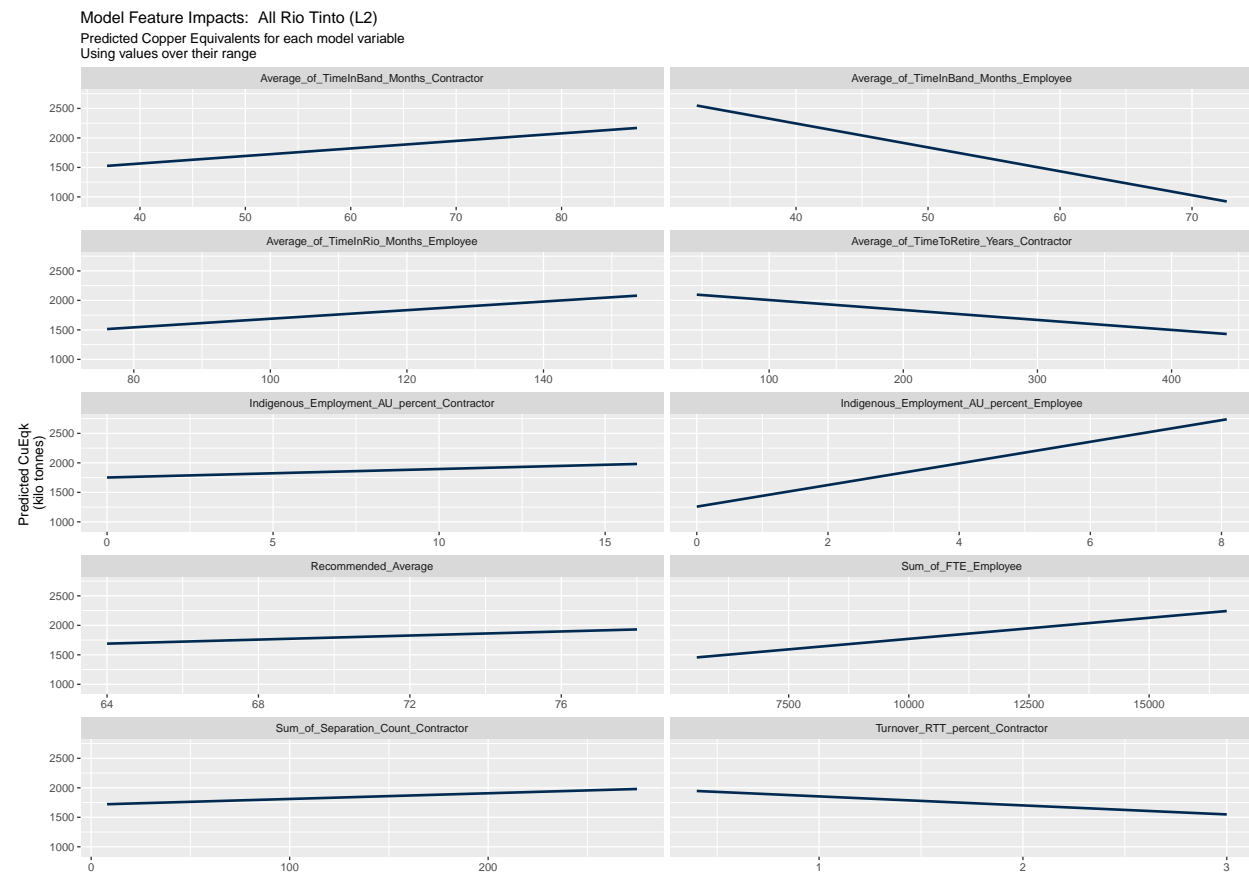
- an increase in *Recommended\_Average* of 1 corresponds to a increase in the CuEqk by 19.26 kilo tonnes.
- an increase in *Sum\_of\_FTE\_Employee* of 1 corresponds to a increase in the CuEqk by 0.07 kilo tonnes.
- an increase in *Average\_of\_TimeInRio\_Months\_Employee* of 1 corresponds to a increase in the CuEqk by 7.32 kilo tonnes.
- an increase in *Average\_of\_TimeInBand\_Months\_Contractor* of 1 corresponds to a increase in the CuEqk by 13.43 kilo tonnes.
- an increase in *Average\_of\_TimeInBand\_Months\_Employee* of 1 corresponds to a decrease in the CuEqk by -39.97 kilo tonnes.
- an increase in *Average\_of\_TimeToRetire\_Years\_Contractor* of 1 corresponds to a decrease in the CuEqk by -1.62 kilo tonnes.
- an increase in *Indigenous\_Employment\_AU\_percent\_Contractor* of 1 corresponds to a increase in the CuEqk by 17.8 kilo tonnes.
- an increase in *Indigenous\_Employment\_AU\_percent\_Employee* of 1 corresponds to a increase in the CuEqk by 186.29 kilo tonnes.
- an increase in *Sum\_of\_Separation\_Count\_Contractor* of 1 corresponds to a increase in the CuEqk by 1.18 kilo tonnes.
- an increase in *Turnover\_RTT\_percent\_Contractor* of 1 corresponds to a decrease in the CuEqk by -130.08 kilo tonnes.

<sup>2</sup>For each statement above, all other variables in the model are held constant.









## Aluminium

Adjusted R-squared = 0.923

Mean Absolute Error = 15.6 kilo tonnes CuEqk

Mean Absolute Percentage Error = 0.85 percent

n\_samples = 26

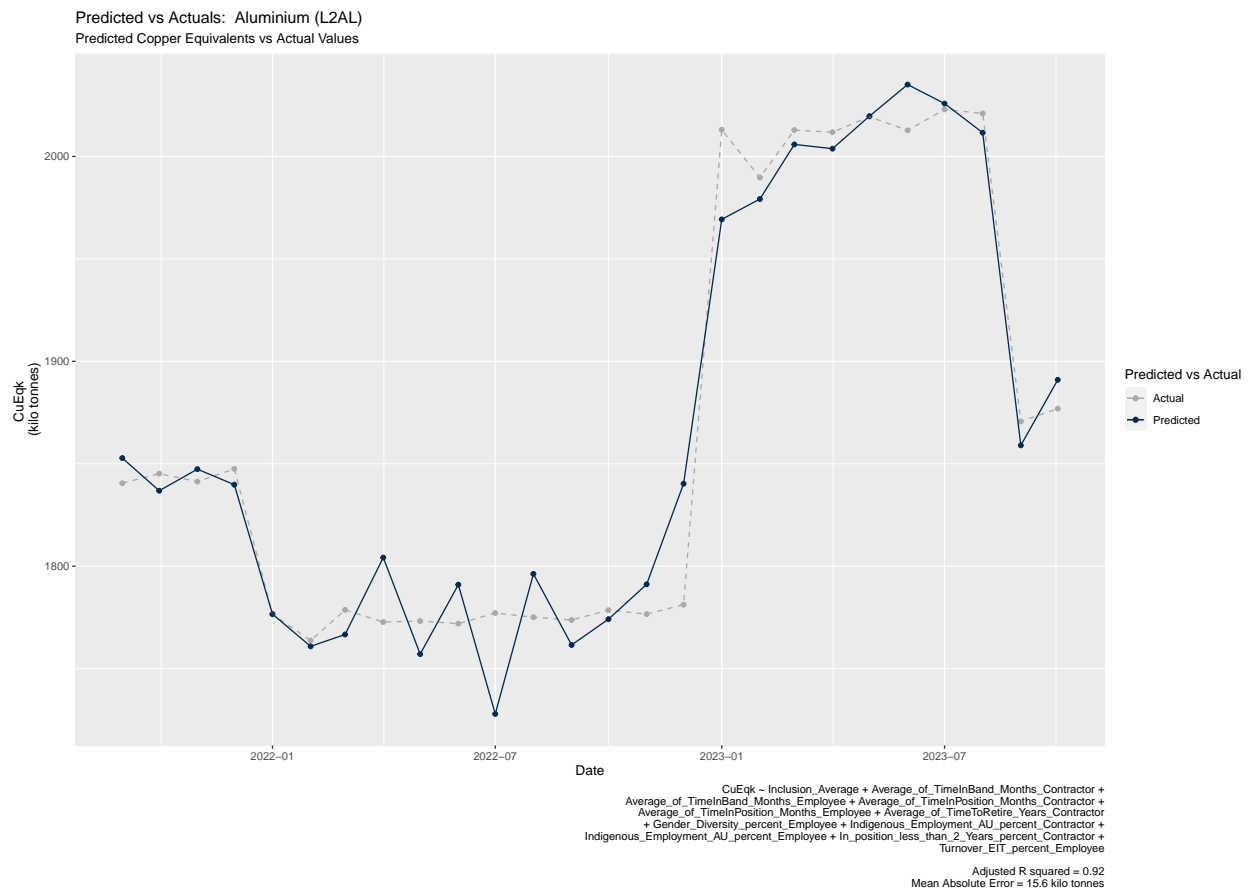
Model Coefficients:

Coefficient	Estimate	p_value
Inclusion_Average	-81.26	0.00
Average_of_TimeInBand_Months_Contractor	-69.36	0.00
Average_of_TimeInBand_Months_Employee	141.79	0.00
Average_of_TimeInPosition_Months_Contractor	-86.97	0.00
Average_of_TimeInPosition_Months_Employee	57.50	0.03
Average_of_TimeToRetire_Years_Contractor	2.44	0.04
Gender_Diversity_percent_Employee	216.16	0.00
Indigenous_Employment_AU_percent_Contractor	23.24	0.00
Indigenous_Employment_AU_percent_Employee	548.25	0.01
In_position_less_than_2_Years_percent_Contractor	-25.55	0.01
Turnover_EIT_percent_Employee	86.73	0.00



From the table above we see that:<sup>3</sup>

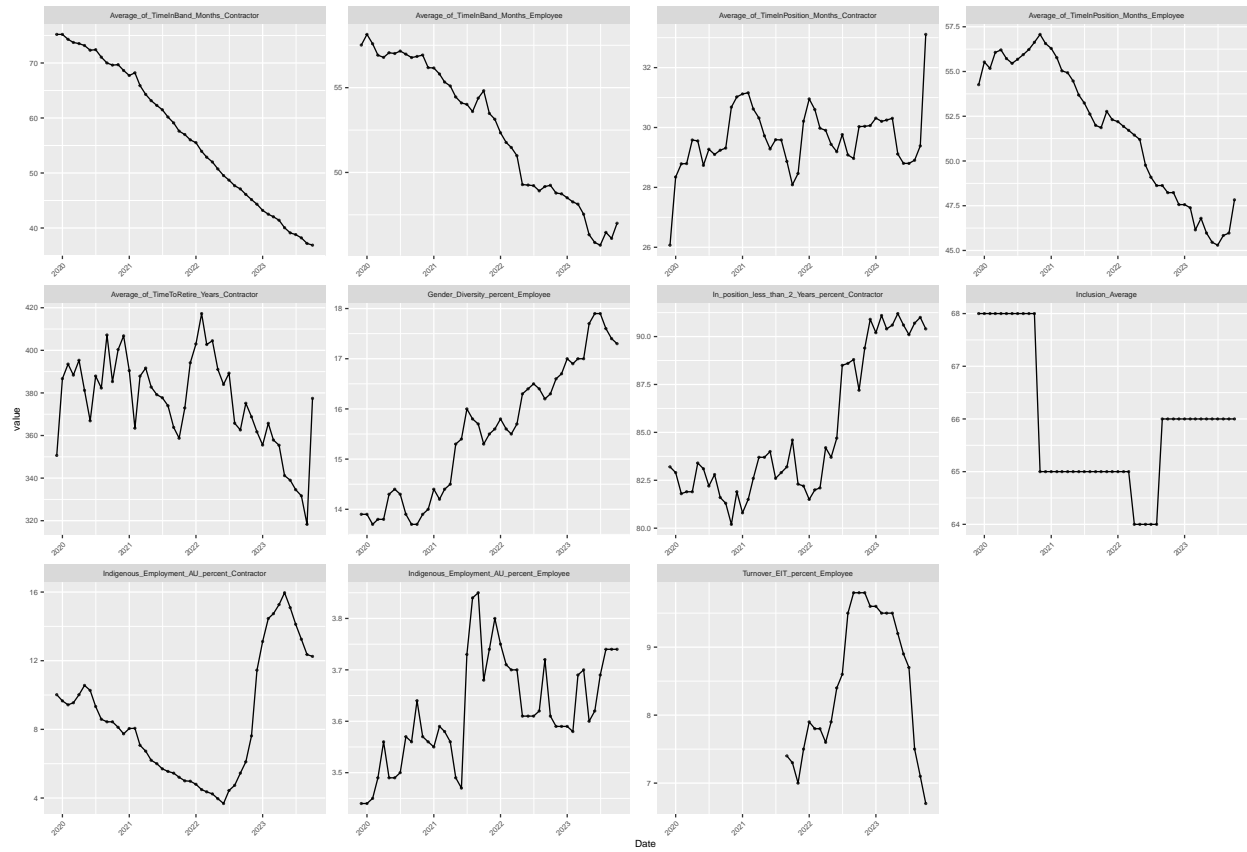
- an increase in *Inclusion\_Average* of 1 corresponds to a decrease in the CuEqk by -81.26 kilo tonnes.
- an increase in *Average\_of\_TimeInBand\_Months\_Contractor* of 1 corresponds to a decrease in the CuEqk by -69.36 kilo tonnes.
- an increase in *Average\_of\_TimeInBand\_Months\_Employee* of 1 corresponds to a increase in the CuEqk by 141.79 kilo tonnes.
- an increase in *Average\_of\_TimeInPosition\_Months\_Contractor* of 1 corresponds to a decrease in the CuEqk by -86.97 kilo tonnes.
- an increase in *Average\_of\_TimeInPosition\_Months\_Employee* of 1 corresponds to a increase in the CuEqk by 57.5 kilo tonnes.
- an increase in *Average\_of\_TimeToRetire\_Years\_Contractor* of 1 corresponds to a increase in the CuEqk by 2.44 kilo tonnes.
- an increase in *Gender\_Diversity\_percent\_Employee* of 1 corresponds to a increase in the CuEqk by 216.16 kilo tonnes.
- an increase in *Indigenous\_Employment\_AU\_percent\_Contractor* of 1 corresponds to a increase in the CuEqk by 23.24 kilo tonnes.
- an increase in *Indigenous\_Employment\_AU\_percent\_Employee* of 1 corresponds to a increase in the CuEqk by 548.25 kilo tonnes.
- an increase in *In\_position\_less\_than\_2\_Years\_percent\_Contractor* of 1 corresponds to a decrease in the CuEqk by -25.55 kilo tonnes.
- an increase in *Turnover\_EIT\_percent\_Employee* of 1 corresponds to a increase in the CuEqk by 86.73 kilo tonnes.

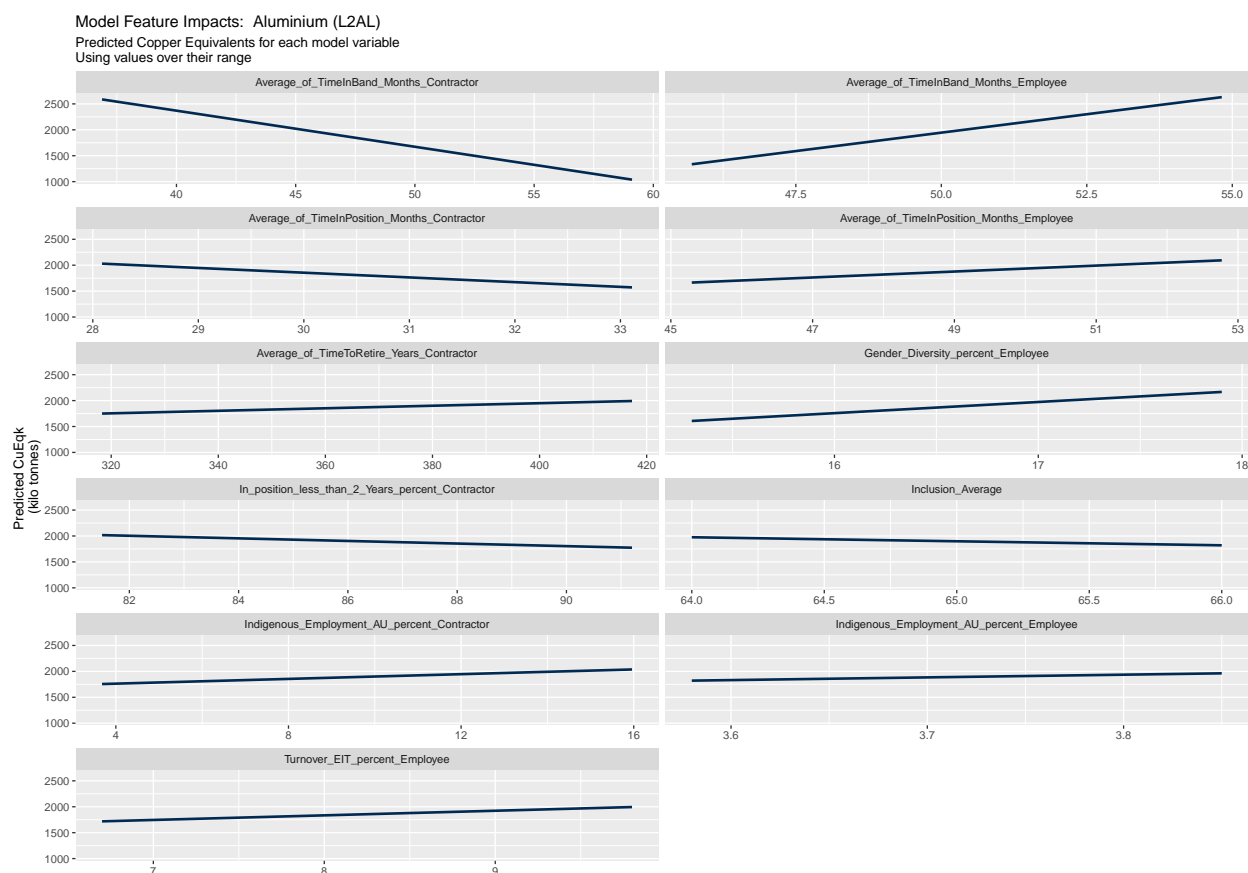


<sup>3</sup>For each statement above, all other variables in the model are held constant.

## Model feature history: Aluminium (L2AL)

Model feature past values over time





## Iron Ore

### Reduced Model:

Adjusted R-squared = 0.698

Mean Absolute Error = 49.3 kilo tonnes CuEqk

Mean Absolute Percentage Error = 1.66 percent

n\_samples = 47

Model Coefficients:

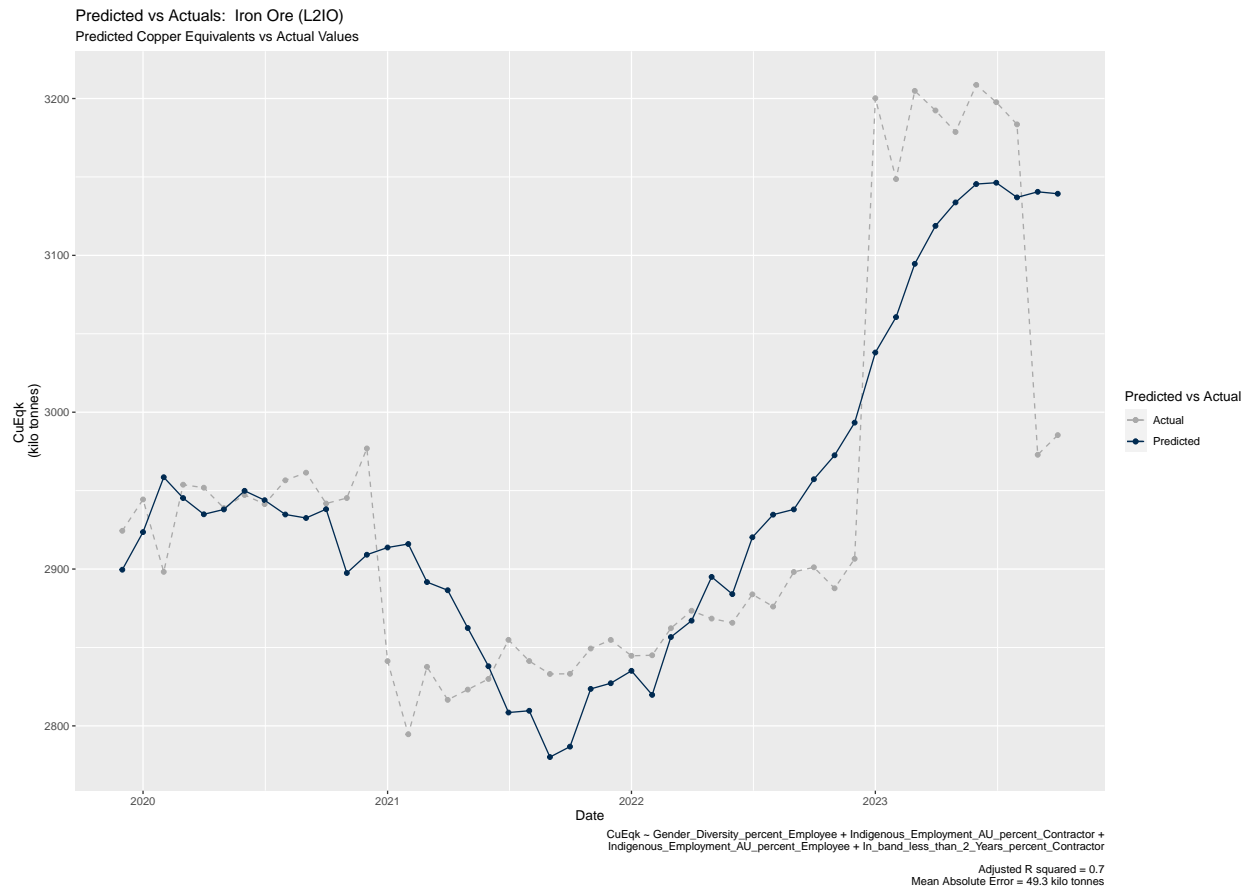
Coefficient	Estimate	p_value
Gender_Diversity_percent_Employee	-62.81	0.03
Indigenous_Employment_AU_percent_Contractor	14.51	0.44
Indigenous_Employment_AU_percent_Employee	-230.11	0.00
In_band_less_than_2_Years_percent_Contractor	4.10	0.01

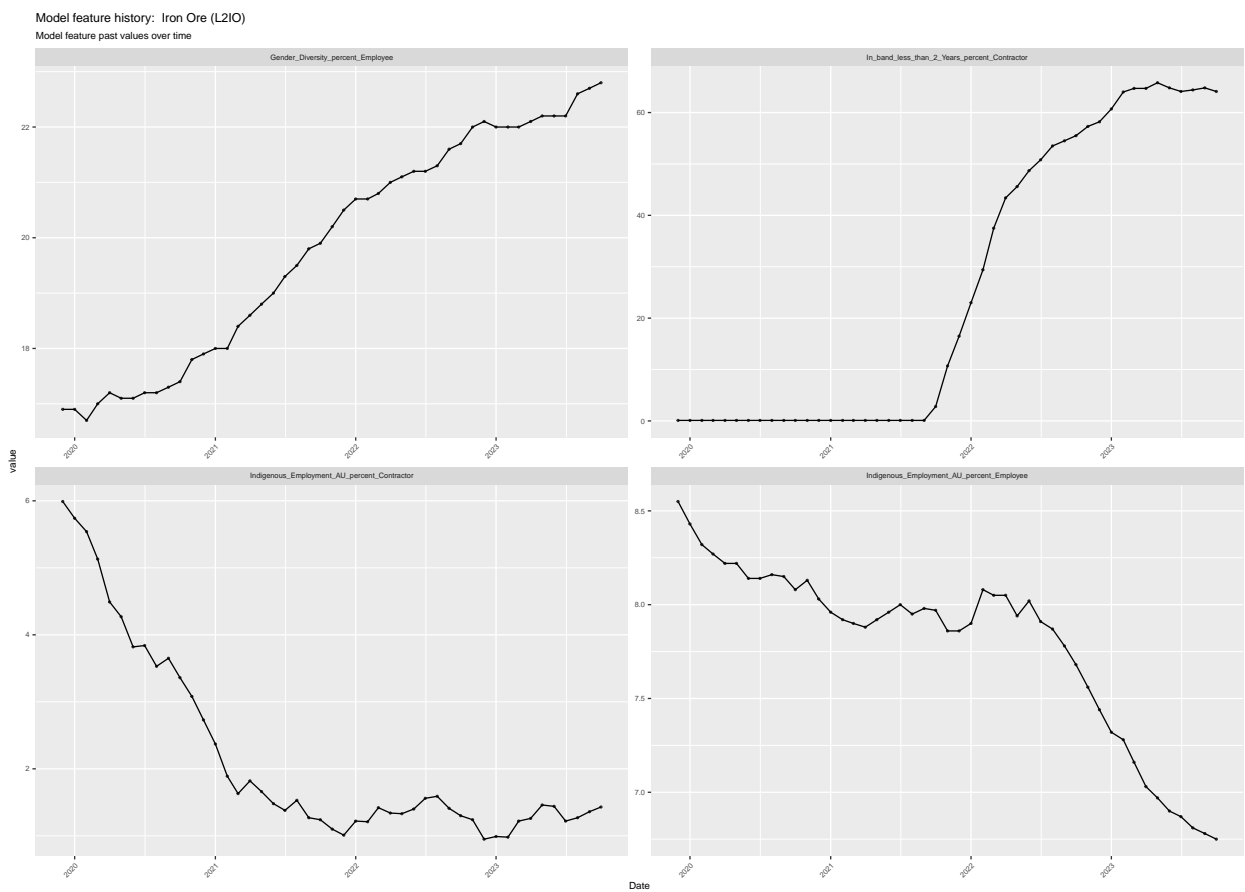
From the table above we see that:<sup>4</sup>

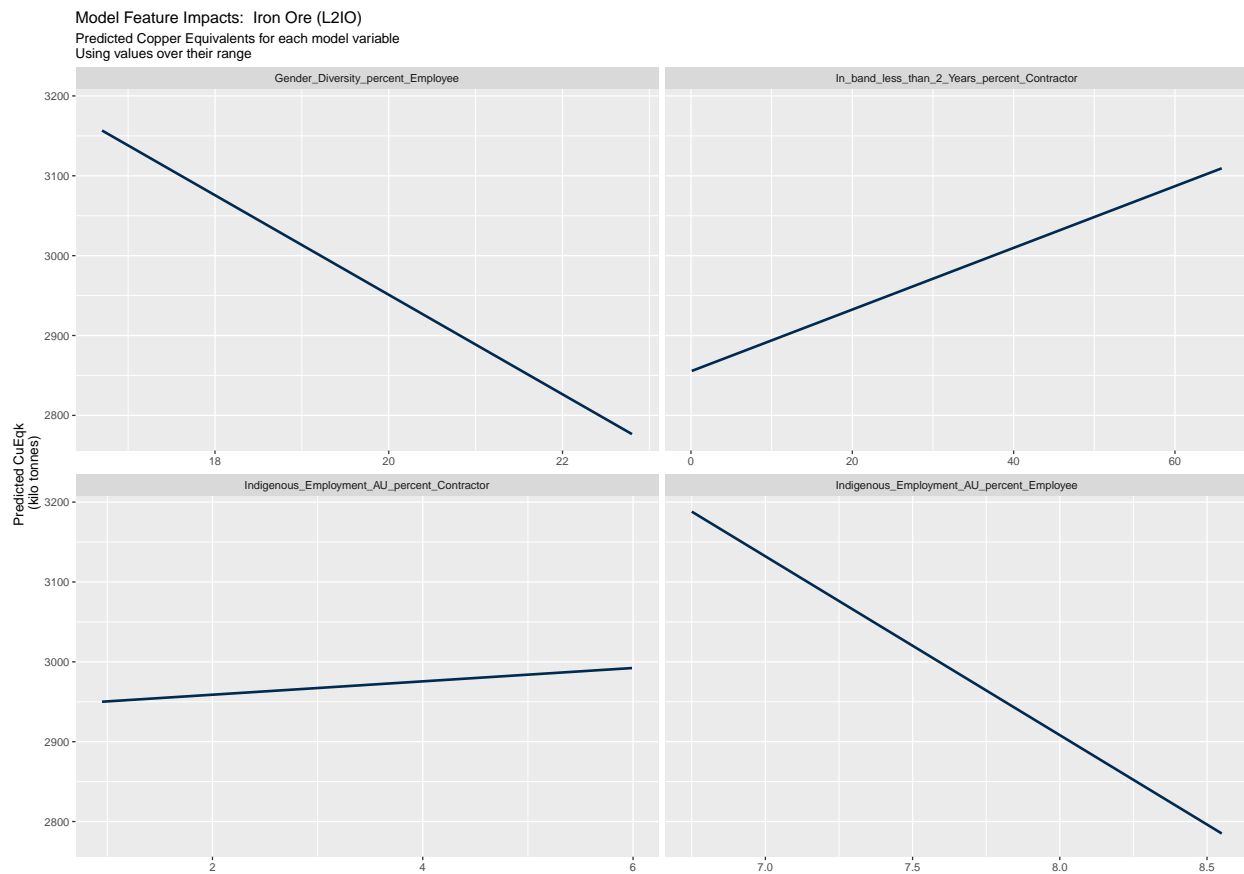
- an increase in *Gender\_Diversity\_percent\_Employee* of 1 corresponds to a decrease in the CuEqk by -62.81 kilo tonnes.

<sup>4</sup>For each statement above, all other variables in the model are held constant.

- an increase in *Indigenous\_Employment\_AU\_percent\_Contractor* of 1 corresponds to a increase in the CuEqk by 14.51 kilo tonnes.
- an increase in *Indigenous\_Employment\_AU\_percent\_Employee* of 1 corresponds to a decrease in the CuEqk by -230.11 kilo tonnes.
- an increase in *In\_band\_less\_than\_2\_Years\_percent\_Contractor* of 1 corresponds to a increase in the CuEqk by 4.1 kilo tonnes.







### Full Model:

Adjusted R-squared = 0.974

Mean Absolute Error = 14.2 kilo tonnes CuEqk

Mean Absolute Percentage Error = 0.47 percent

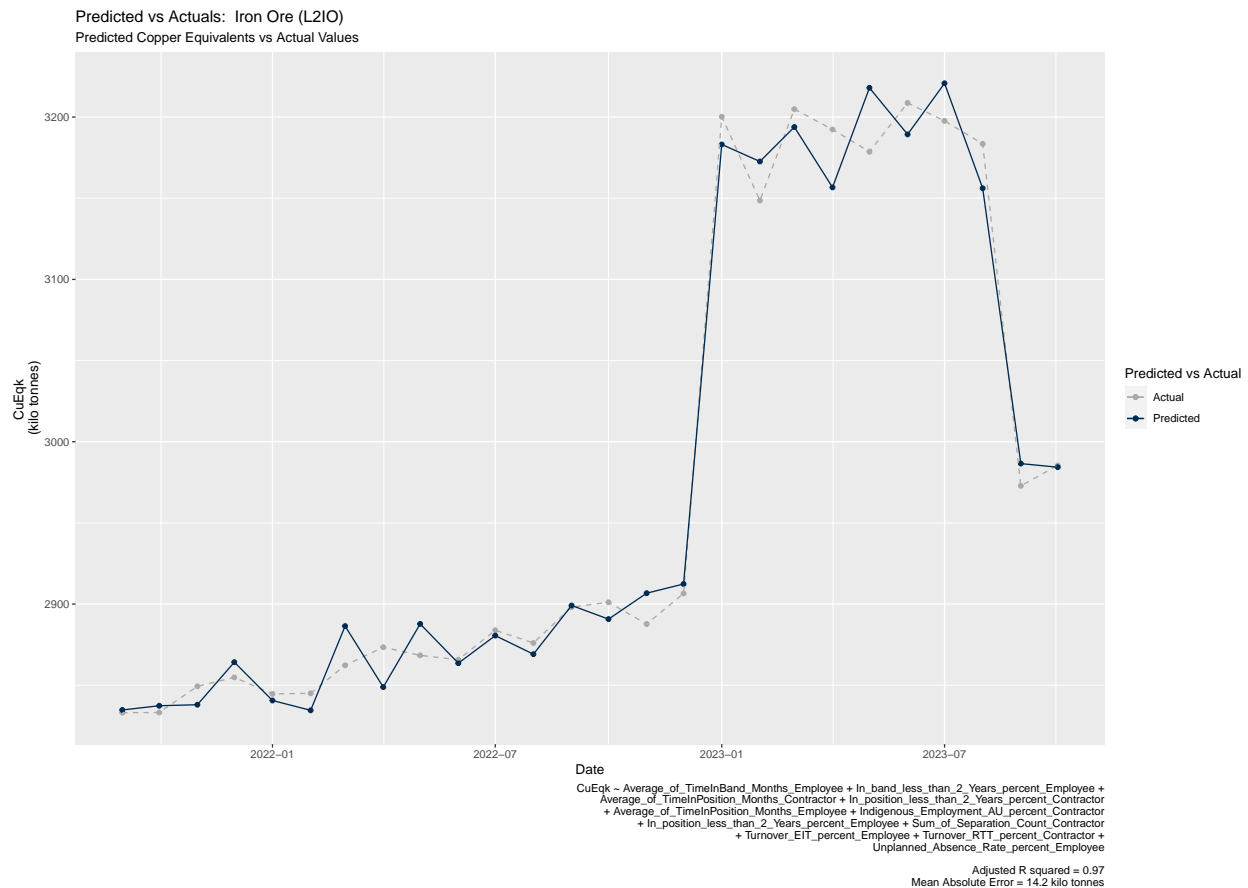
n\_samples = 26

Model Coefficients:

Coefficient	Estimate	p_value
Average_of_TimeInBand_Months_Employee	-153.93	0.00
In_band_less_than_2_Years_percent_Employee	-101.37	0.00
Average_of_TimeInPosition_Months_Contractor	-67.37	0.00
In_position_less_than_2_Years_percent_Contractor	-27.97	0.00
Average_of_TimeInPosition_Months_Employee	-287.32	0.00
Indigenous_Employment_AU_percent_Contractor	-142.34	0.00
In_position_less_than_2_Years_percent_Employee	-55.92	0.03
Sum_of_Separation_Count_Contractor	2.70	0.00
Turnover_EIT_percent_Employee	-122.90	0.00
Turnover_RTT_percent_Contractor	-139.64	0.00
Unplanned_Absence_Rate_percent_Employee	36.59	0.00

From the table above we see that:<sup>5</sup>

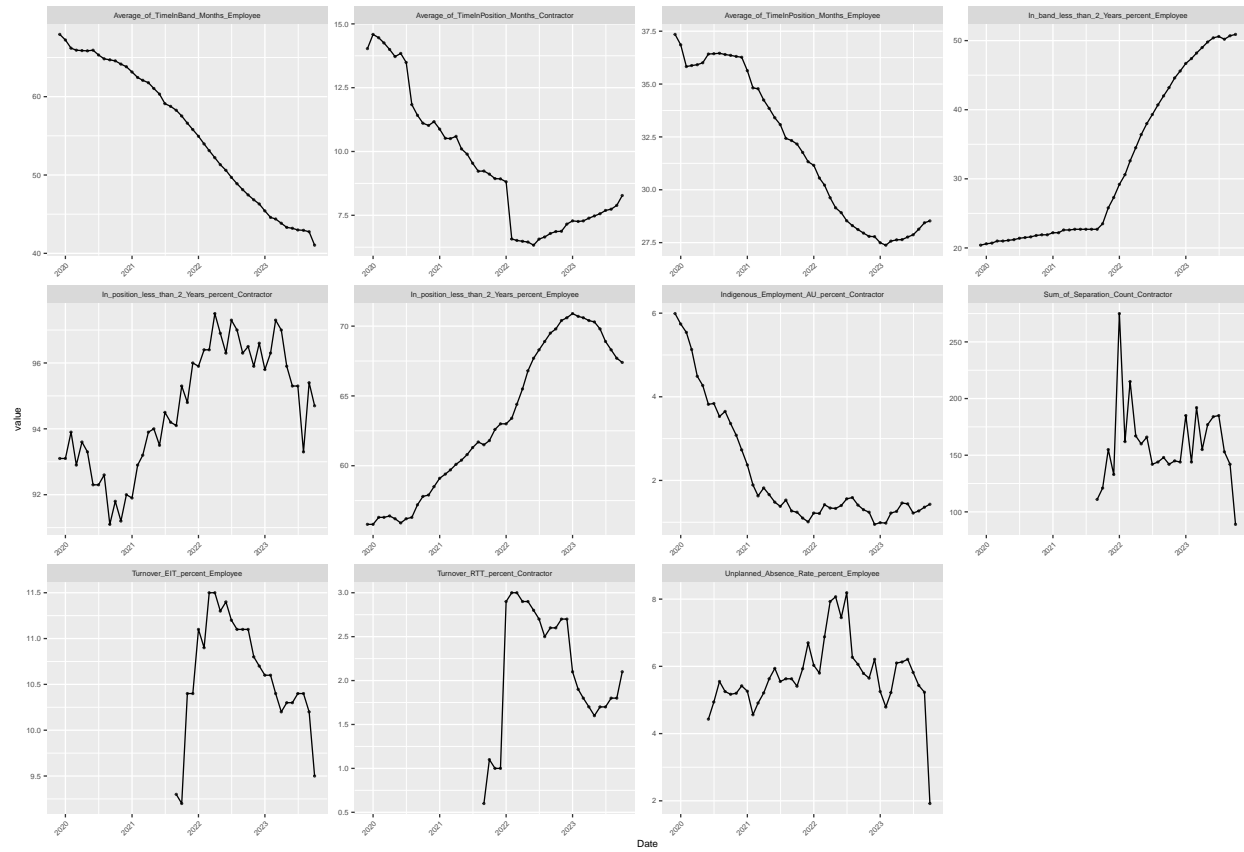
- an increase in *Average\_of\_TimeInBand\_Months\_Employee* of 1 corresponds to a decrease in the CuEqk by -153.93 kilo tonnes.
- an increase in *In\_band\_less\_than\_2\_Years\_percent\_Employee* of 1 corresponds to a decrease in the CuEqk by -101.37 kilo tonnes.
- an increase in *Average\_of\_TimeInPosition\_Months\_Contractor* of 1 corresponds to a decrease in the CuEqk by -67.37 kilo tonnes.
- an increase in *In\_position\_less\_than\_2\_Years\_percent\_Contractor* of 1 corresponds to a decrease in the CuEqk by -27.97 kilo tonnes.
- an increase in *Average\_of\_TimeInPosition\_Months\_Employee* of 1 corresponds to a decrease in the CuEqk by -287.32 kilo tonnes.
- an increase in *Indigenous\_Employment\_AU\_percent\_Contractor* of 1 corresponds to a decrease in the CuEqk by -142.34 kilo tonnes.
- an increase in *In\_position\_less\_than\_2\_Years\_percent\_Employee* of 1 corresponds to a decrease in the CuEqk by -55.92 kilo tonnes.
- an increase in *Sum\_of\_Separation\_Count\_Contractor* of 1 corresponds to an increase in the CuEqk by 2.7 kilo tonnes.
- an increase in *Turnover\_EIT\_percent\_Employee* of 1 corresponds to a decrease in the CuEqk by -122.9 kilo tonnes.
- an increase in *Turnover\_RTT\_percent\_Contractor* of 1 corresponds to a decrease in the CuEqk by -139.64 kilo tonnes.
- an increase in *Unplanned\_Absence\_Rate\_percent\_Employee* of 1 corresponds to an increase in the CuEqk by 36.59 kilo tonnes.



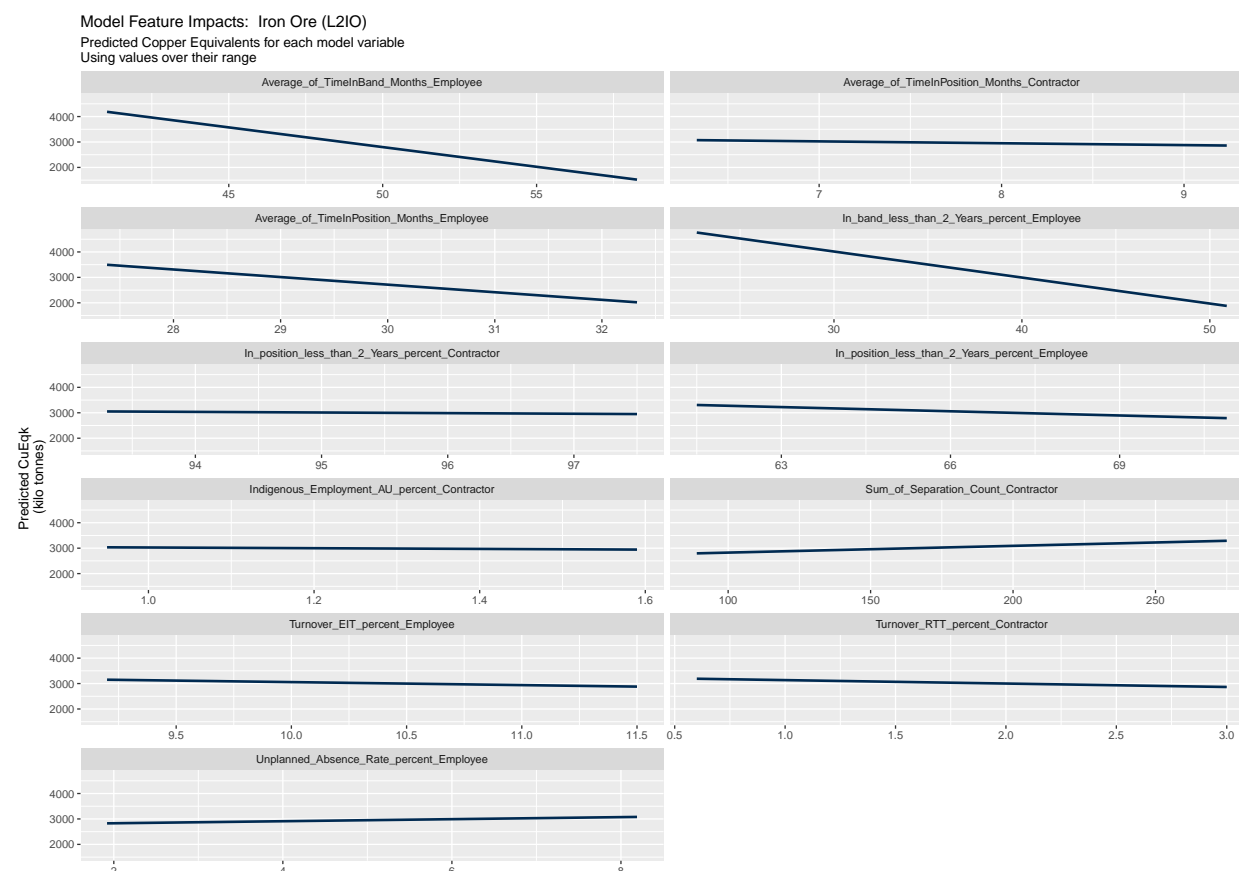
<sup>5</sup>For each statement above, all other variables in the model are held constant.

## Model feature history: Iron Ore (L2IO)

Model feature past values over time







## Copper

**Adjusted R-squared = 0.867**

**Mean Absolute Error = 19.3 kilo tonnes CuEqk**

**Mean Absolute Percentage Error = 1.21 percent**

**n\_samples = 26**

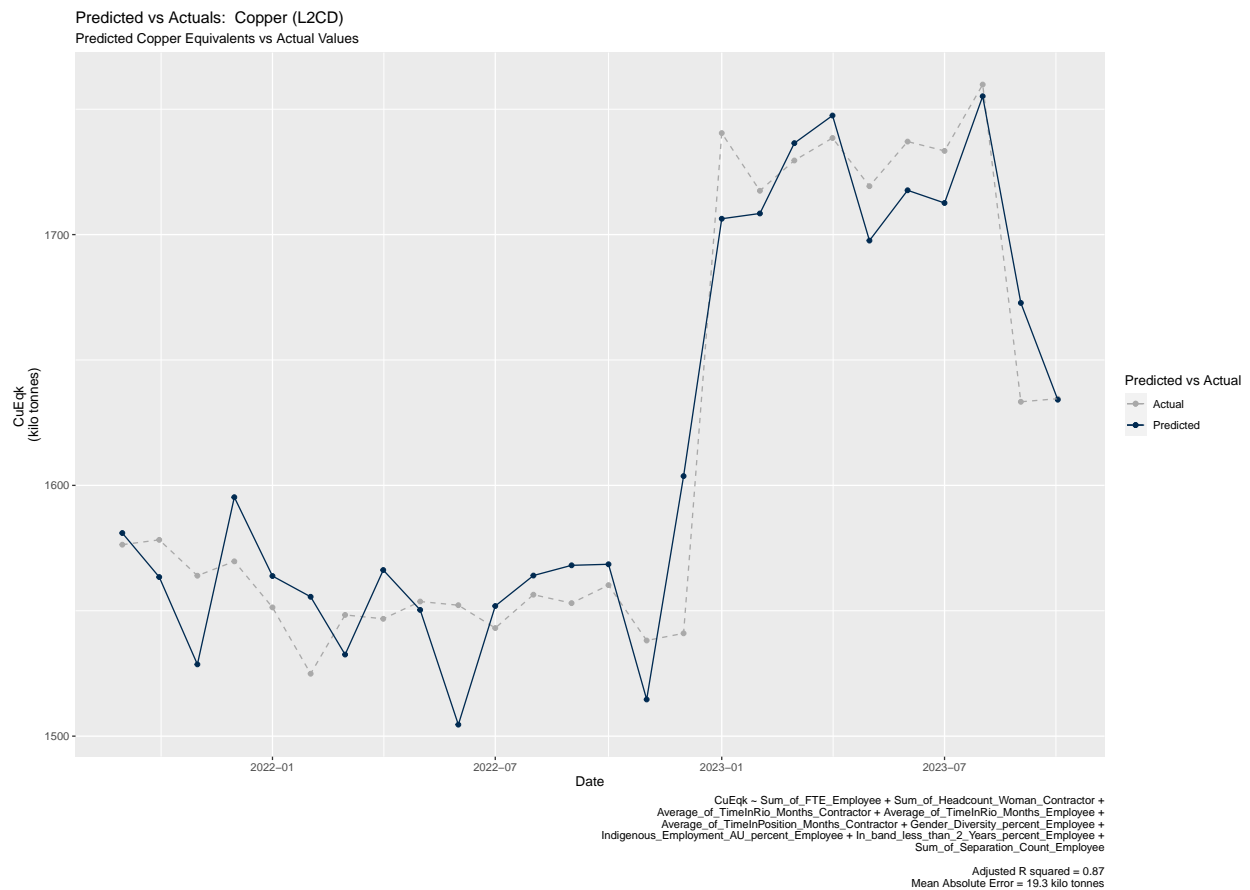
**Model Coefficients:**

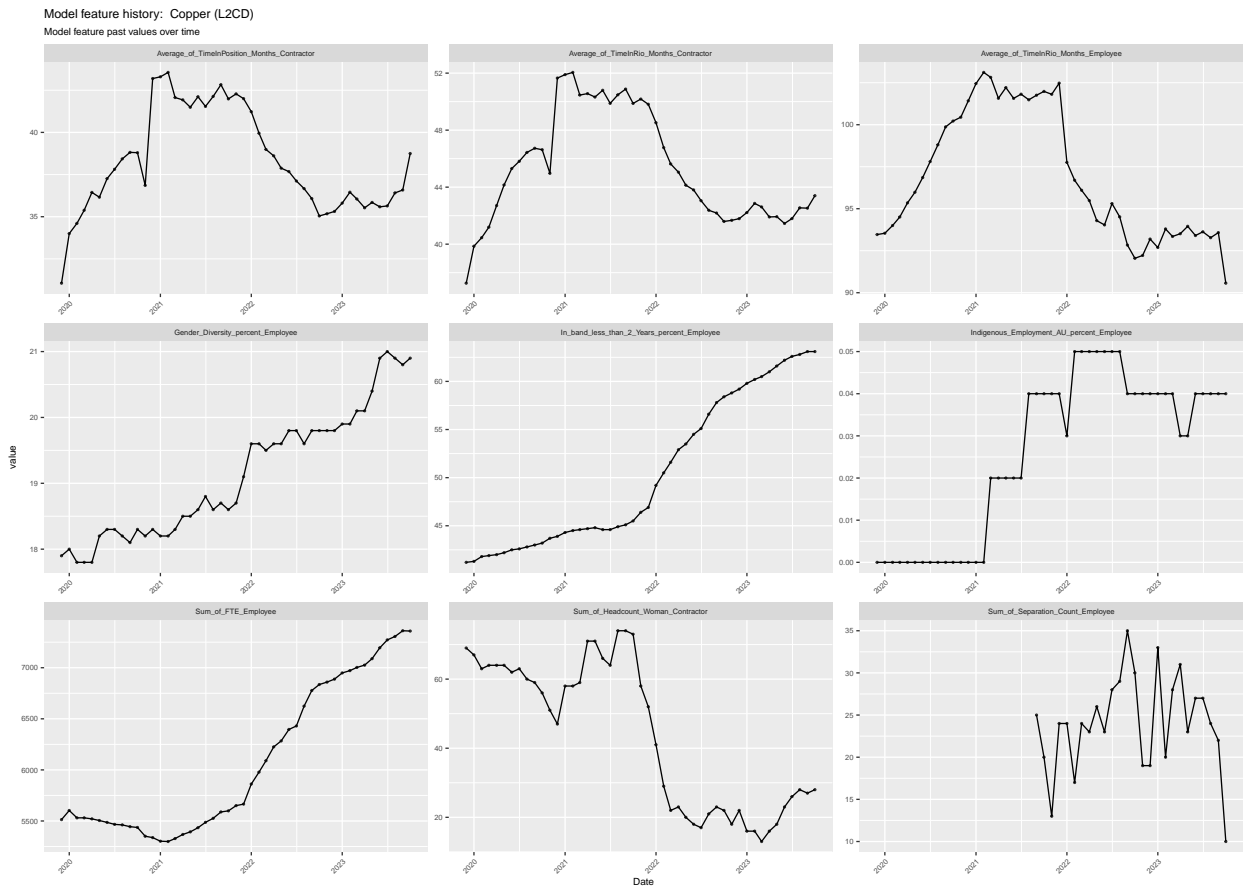
Coefficient	Estimate	p_value
Sum_of_FTE_Employee	-2.58	0.00
Sum_of_Headcount_Woman_Contractor	10.97	0.00
Average_of_TimeInRio_Months_Contractor	128.93	0.00
Average_of_TimeInRio_Months_Employee	-18.48	0.10
Average_of_TimeInPosition_Months_Contractor	-60.96	0.02
Gender_Diversity_percent_Employee	-75.73	0.03
Indigenous_Employment_AU_percent_Employee	8792.80	0.00
In_band_less_than_2_Years_percent_Employee	328.56	0.00
Sum_of_Separation_Count_Employee	7.20	0.00

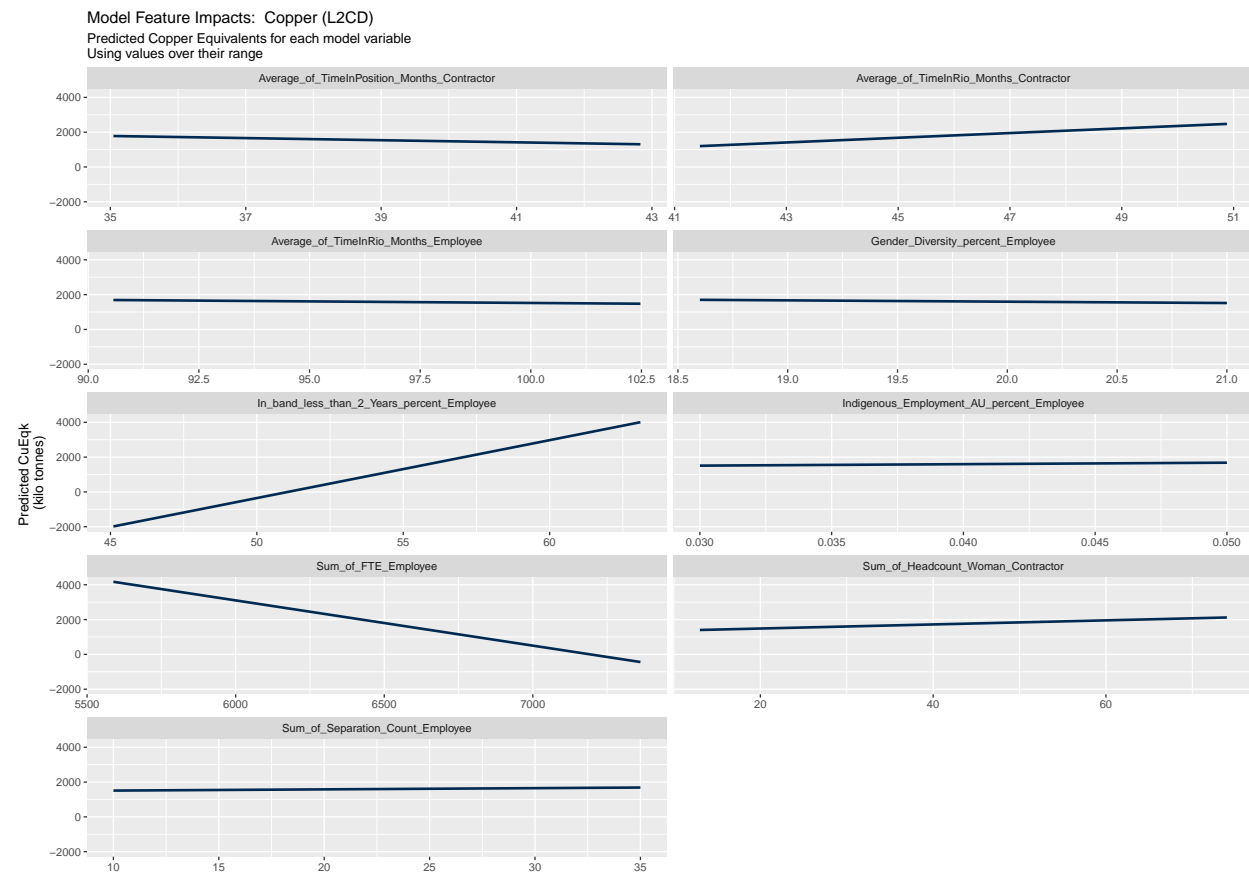
From the table above we see that:<sup>6</sup>

<sup>6</sup>For each statement above, all other variables in the model are held constant.

- an increase in *Sum\_of\_FTE\_Employee* of 1 corresponds to a decrease in the CuEqk by -2.58 kilo tonnes.
- an increase in *Sum\_of\_Headcount\_Woman\_Contractor* of 1 corresponds to a increase in the CuEqk by 10.97 kilo tonnes.
- an increase in *Average\_of\_TimeInRio\_Months\_Contractor* of 1 corresponds to a increase in the CuEqk by 128.93 kilo tonnes.
- an increase in *Average\_of\_TimeInRio\_Months\_Employee* of 1 corresponds to a decrease in the CuEqk by -18.48 kilo tonnes.
- an increase in *Average\_of\_TimeInPosition\_Months\_Contractor* of 1 corresponds to a decrease in the CuEqk by -60.96 kilo tonnes.
- an increase in *Gender\_Diversity\_percent\_Employee* of 1 corresponds to a decrease in the CuEqk by -75.73 kilo tonnes.
- an increase in *Indigenous\_Employment\_AU\_percent\_Employee* of 1 corresponds to a increase in the CuEqk by 8792.8 kilo tonnes.
- an increase in *In\_band\_less\_than\_2\_Years\_percent\_Employee* of 1 corresponds to a increase in the CuEqk by 328.56 kilo tonnes.
- an increase in *Sum\_of\_Separation\_Count\_Employee* of 1 corresponds to a increase in the CuEqk by 7.2 kilo tonnes.







## Minerals

Adjusted R-squared = 0.673

Mean Absolute Error = 6.3 kilo tonnes CuEqk

Mean Absolute Percentage Error = 1.13 percent

n\_samples = 41

Model Coefficients:

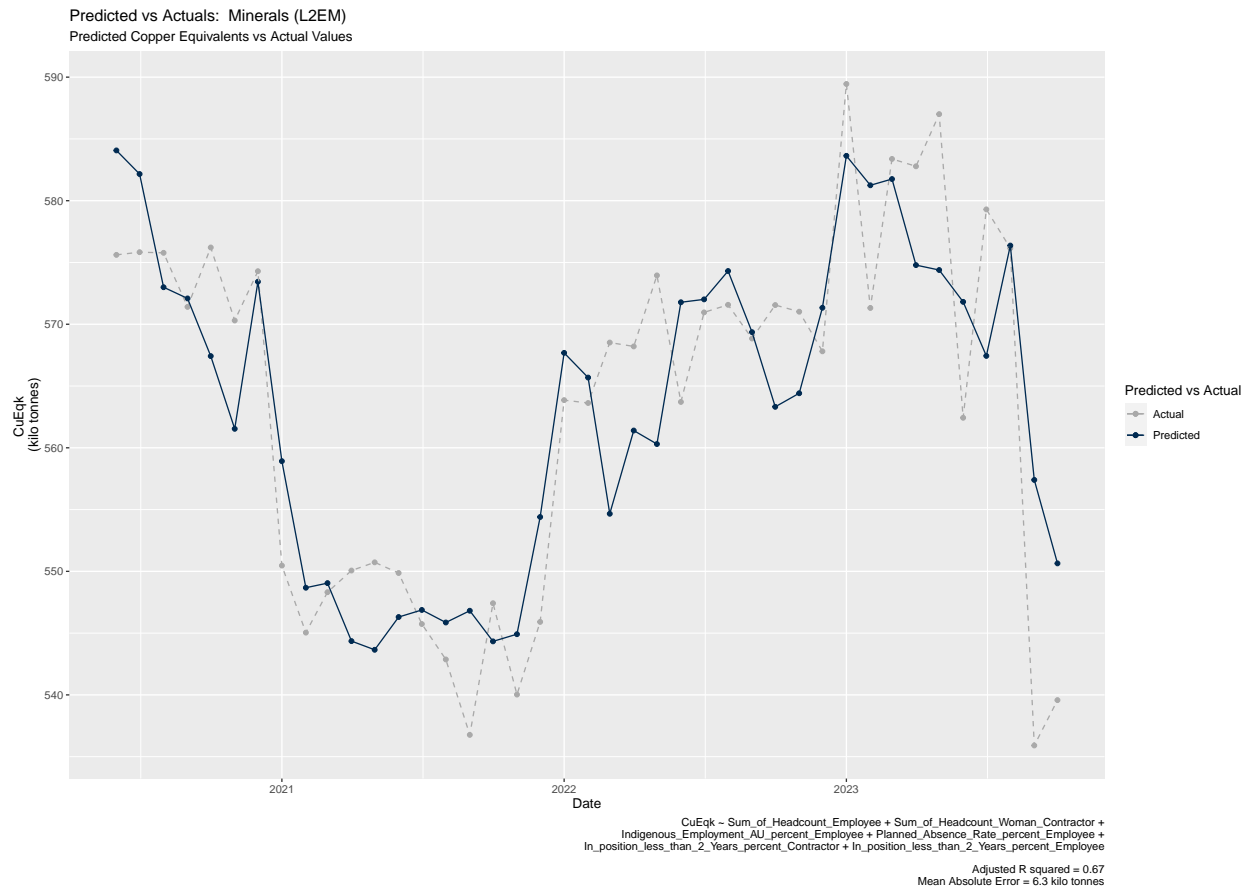
Coefficient	Estimate	p_value
Sum_of_Headcount_Employee	-0.10	0.00
Sum_of_Headcount_Woman_Contractor	1.69	0.01
Indigenous_Employment_AU_percent_Employee	99.97	0.00
Planned_Absence_Rate_percent_Employee	1.33	0.04
In_position_less_than_2_Years_percent_Contractor	-1.66	0.00
In_position_less_than_2_Years_percent_Employee	12.90	0.00

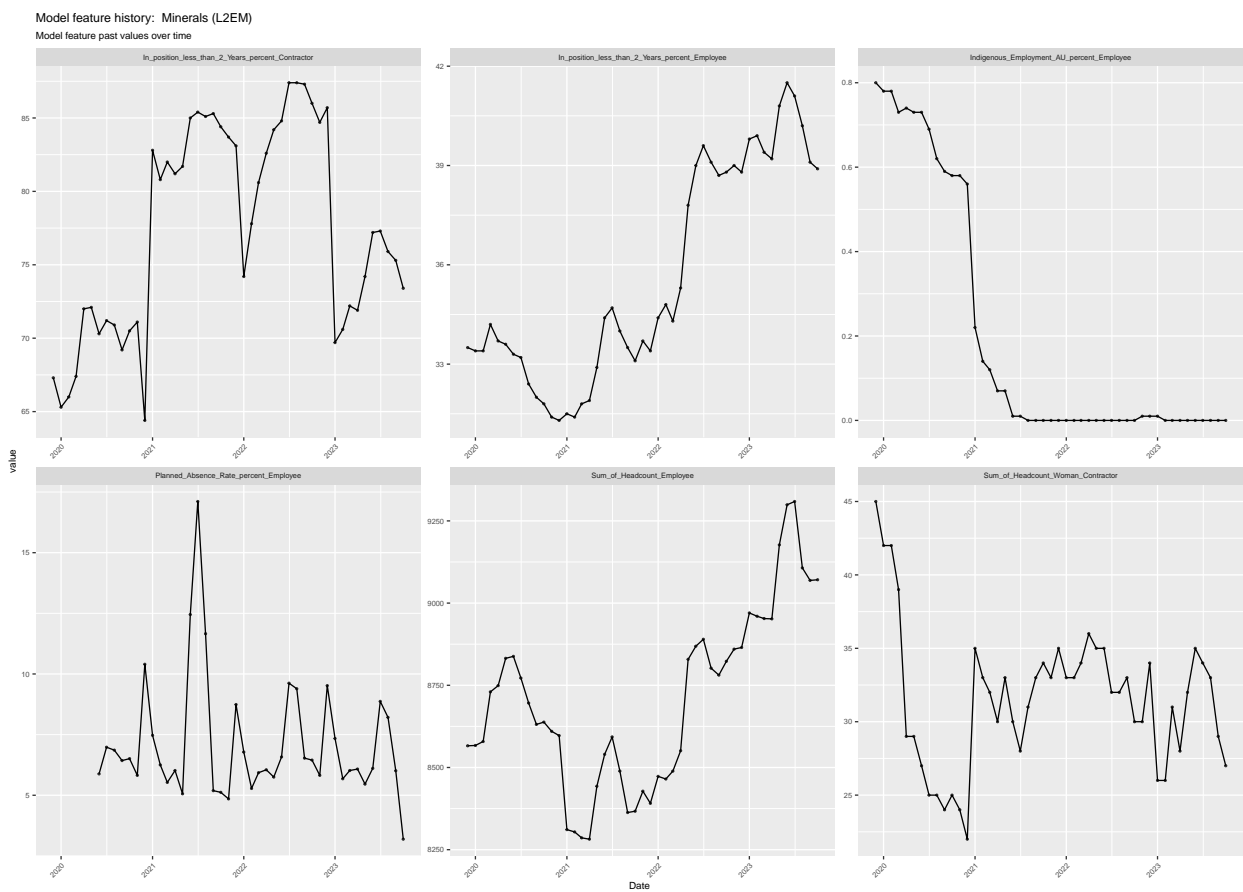
From the table above we see that:<sup>7</sup>

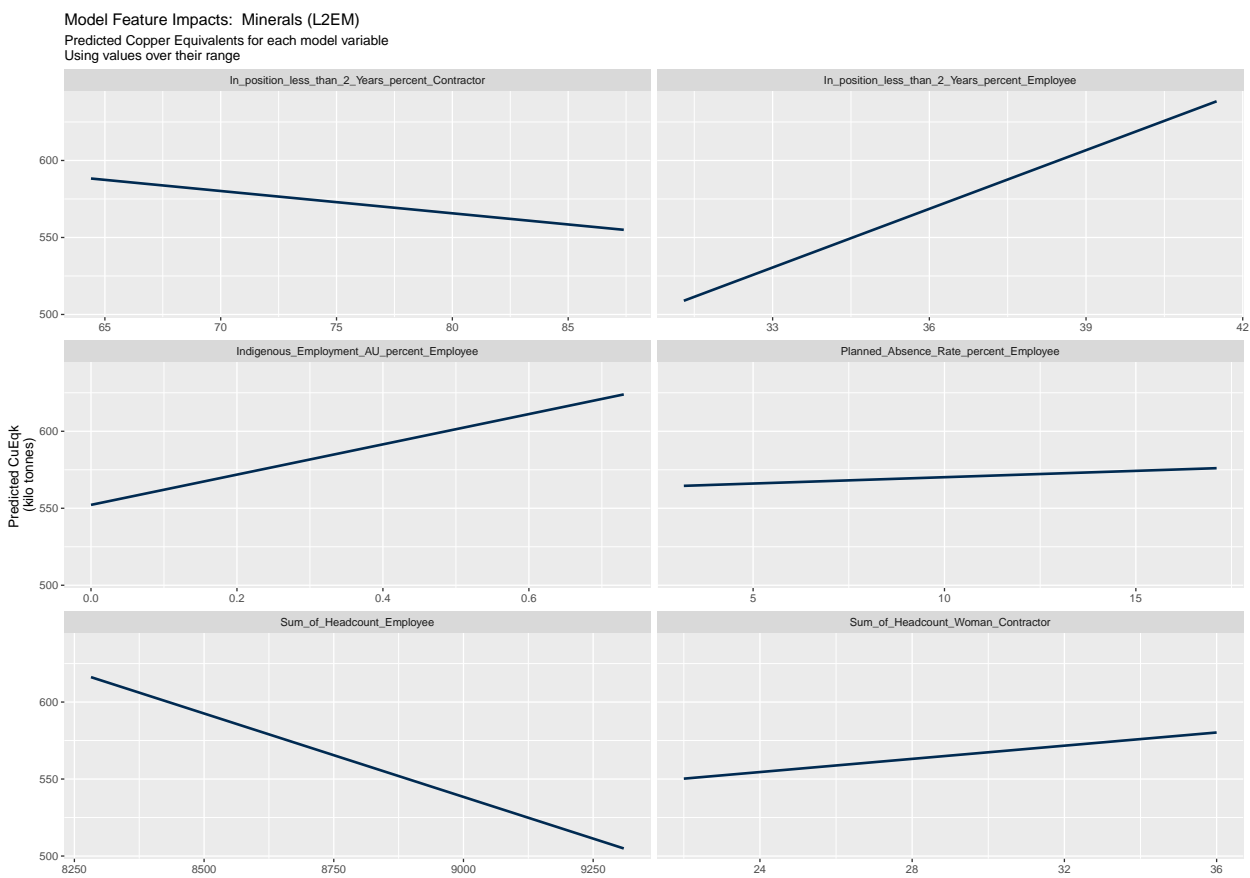
- an increase in *Sum\_of\_Headcount\_Employee* of 1 corresponds to a decrease in the CuEqk by -0.1 kilo tonnes.

<sup>7</sup>For each statement above, all other variables in the model are held constant.

- an increase in *Sum\_of\_Headcount\_Woman\_Contractor* of 1 corresponds to a increase in the CuEqk by 1.69 kilo tonnes.
- an increase in *Indigenous\_Employment\_AU\_percent\_Employee* of 1 corresponds to a increase in the CuEqk by 99.97 kilo tonnes.
- an increase in *Planned\_Absence\_Rate\_percent\_Employee* of 1 corresponds to a increase in the CuEqk by 1.33 kilo tonnes.
- an increase in *In\_position\_less\_than\_2\_Years\_percent\_Contractor* of 1 corresponds to a decrease in the CuEqk by -1.66 kilo tonnes.
- an increase in *In\_position\_less\_than\_2\_Years\_percent\_Employee* of 1 corresponds to a increase in the CuEqk by 12.9 kilo tonnes.







## Appendix

### Definitions of Terms:

- **Adjusted R-squared:** an accuracy metric for regression models that indicates the percentage of the variability in the dependent variable (kilo tonnes of CuEq) that can be explained by the independent variables (predictors) included in the model.
- **Mean Absolute Error:** MAE measures the average magnitude of the errors.
- **Mean Absolute Percentage Error:** MAPE measures the average percentage difference between predicted and actual values (errors).
- **n:** The sample size, or number of observations used to fit the model.
- **Predictor:** An independent variable fitted in the model.
- **Coefficient value:** A number representing the expected change in the dependent variable (kilo tonnes of CuEq) for a one-unit increase in the independent variable (predictor), holding all other variables constant.
- **p-value:** A number representing the statistical significance of that predictor in the model. Note - All predictors included here are statistically significant.

### Definitions of all Features considered:

**eSAT\_Average:** Average *eSAT* scores from Glint People Survey,  
**Inclusion\_Average:** Average *Inclusion* scores from Glint People Survey,  
**Respect\_Average:** Average *Respect* scores from Glint People Survey,  
**Participation\_Average:** Average *Participation* scores from Glint People Survey,  
**Recommended\_Average:** Average *Recommended* scores from Glint People Survey,  
**Sum\_of\_FTE\_Contractor:** Sum of Full Time Equivalent metric for contractors,  
**Sum\_of\_FTE\_Employee:** Sum of Full Time Equivalent metric for employees,  
**Sum\_of\_Headcount\_Contractor:** Sum of headcount for contractors,  
**Sum\_of\_Headcount\_Employee:** Sum of headcount for employees,  
**Sum\_of\_Headcount\_Woman\_Contractor:** Sum of headcount for woman contractors,  
**Sum\_of\_Headcount\_Woman\_Employee:** Sum of headcount for woman employees,  
**Average\_of\_TimeInRio\_Months\_Contractor:** Average time in Rio for contractors (months),  
**Average\_of\_TimeInRio\_Months\_Employee:** Average time in Rio for employees (months),  
**Average\_of\_TimeInBand\_Months\_Contractor:** Average time in band for contractors (months),  
**Average\_of\_TimeInBand\_Months\_Employee:** Average time in band for employees (months),  
**Average\_of\_TimeInPosition\_Months\_Contractor:** Average time in position for contractors (months),  
**Average\_of\_TimeInPosition\_Months\_Employee :** Average time in position for employees (months),  
**Average\_of\_TimeToRetire\_Years\_Contractor:** Average time to retirement for contractors (years),  
**Average\_of\_TimeToRetire\_Years\_Employee:** Average time to retirement for employees (years),  
**Gender\_Diversity\_Contractor\_percent:** Percentage of woman contractors,  
**Gender\_Diversity\_Employee\_percent:** Percentage of woman employees,  
**Graduate\_Gender\_Diversity\_Employee\_percent:** Percentage of woman graduates,  
**Indigenous\_Employment\_AU\_Contractor\_percent:** percentage of indigenous contractors,  
**Indigenous\_Employment\_AU\_Employee\_percent:** percentage of indigenous employees,  
**In\_band\_less\_than\_2\_Years\_Contractor\_percent:** percentage of contractors in their band for less than 2 years,  
**In\_band\_less\_than\_2\_Years\_Employee\_percent:** percentage of employees in their band for less than 2 years,  
**In\_position\_less\_than\_2\_Years\_Contractor\_percent:** percentage of contractors in their position for less than 2



years,

**In\_position\_less\_than\_2\_Years\_Employee\_percent:** percentage of employees in their position for less than 2 years,

**Sum\_of\_Separation\_Count\_Contractor:** Sum of contractor separations,

**Sum\_of\_Separation\_Count\_Employee:** : Sum of employee separations,

**Turnover\_EIT\_Contractor\_percent:** Voluntary turnover percent (Employee Initiated Terminations) for contractors,

**Turnover\_EIT\_Employee\_percent:** Voluntary turnover percent (Employee Initiated Terminations) for employees,

**Turnover\_RTT\_Contractor\_percent:** Non-voluntary turnover percent (Rio Tinto Terminations) for contractors,

**Turnover\_RTT\_Employee\_percent:** Non-voluntary turnover percent (Rio Tinto Terminations) for employees,

**Absence\_Rate\_Contractor\_percent:** Absence rate percentage (planned and unplanned) for contractors,

**Absence\_Rate\_Employee\_percent:** Absence rate percentage (planned and unplanned) for employees,

**Planned\_Absence\_Rate\_Contractor\_percent:** Planned absence rate percentage for contractors,

**Planned\_Absence\_Rate\_Employee\_percent:** Planned absence rate percentage for employees,

**Unplanned\_Absence\_Rate\_Contractor\_percent:** Unplanned absence rate percentage for contractors,

**Unplanned\_Absence\_Rate\_Employee\_percent:** Unplanned absence rate percentage for employees,

## Model Details

### All Rio

```
##
## Call:
## lm(formula = CuEqk ~ Recommended_Average + Sum_of_FTE_Employee +
##   Average_of_TimeInRio_Months_Employee + Average_of_TimeInBand_Months_Contractor +
##   Average_of_TimeInBand_Months_Employee + Average_of_TimeToRetire_Years_Contractor +
##   Indigenous_Employment_AU_percent_Contractor + Indigenous_Employment_AU_percent_Employee +
##   Sum_of_Separation_Count_Contractor + Turnover_RTT_percent_Contractor,
##   data = .)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -141.180  -31.023    2.231   31.651  111.940
##
## Coefficients:
##              (Intercept)              Estimate Std. Error t value
## Recommended_Average      -5.133e+01  3.594e+02  -0.143
## Sum_of_FTE_Employee       1.926e+01  4.195e+00   4.592
## Average_of_TimeInRio_Months_Employee  7.390e-02  8.824e-03   8.375
## Average_of_TimeInBand_Months_Contractor  7.317e+00  1.867e+00   3.920
## Average_of_TimeInBand_Months_Employee  1.343e+01  2.140e+00   6.277
## Average_of_TimeToRetire_Years_Contractor -3.997e+01  2.445e+00 -16.346
## Indigenous_Employment_AU_percent_Contractor -1.623e+00  3.750e-01  -4.329
## Indigenous_Employment_AU_percent_Employee  1.780e+01  2.861e+00   6.222
## Sum_of_Separation_Count_Contractor  1.863e+02  9.957e+00  18.709
## Turnover_RTT_percent_Contractor  1.179e+00  2.609e-01   4.519
##              Pr(>|t|)
## (Intercept)          0.886749
## Recommended_Average  1.37e-05 ***
## Sum_of_FTE_Employee  5.55e-13 ***
## Average_of_TimeInRio_Months_Employee  0.000169 ***
## Average_of_TimeInBand_Months_Contractor  1.09e-08 ***
## Average_of_TimeInBand_Months_Employee  < 2e-16 ***
## Average_of_TimeToRetire_Years_Contractor  3.78e-05 ***
## Indigenous_Employment_AU_percent_Contractor  1.39e-08 ***
## Indigenous_Employment_AU_percent_Employee  < 2e-16 ***
## Sum_of_Separation_Count_Contractor  1.83e-05 ***
## Turnover_RTT_percent_Contractor  2.41e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 56.12 on 93 degrees of freedom
## (84 observations deleted due to missingness)
## Multiple R-squared:  0.9962, Adjusted R-squared:  0.9958
## F-statistic: 2447 on 10 and 93 DF, p-value: < 2.2e-16
```

### Aluminium

```
##
## Call:
## lm(formula = CuEqk ~ Inclusion_Average + Average_of_TimeInBand_Months_Contractor +
##   Average_of_TimeInBand_Months_Employee + Average_of_TimeInPosition_Months_Contractor +
##   Average_of_TimeInPosition_Months_Employee + Average_of_TimeToRetire_Years_Contractor +
##   Gender_Diversity_percent_Employee + Indigenous_Employment_AU_percent_Contractor +
##   Indigenous_Employment_AU_percent_Employee + In_position_less_than_2_Years_percent_Contractor +
##   Turnover_EIT_percent_Employee, data = .)
##
## Residuals:
```

```
##      Min      1Q  Median      3Q      Max
## -59.041 -13.637   3.609  10.226  49.257
##
## Coefficients:
##              Estimate Std. Error t value
## (Intercept)    -1988.511    2560.317  -0.777
## Inclusion_Average      -81.257     21.406  -3.796
## Average_of_TimeInBand_Months_Contractor    -69.362     17.351  -3.997
## Average_of_TimeInBand_Months_Employee     141.788     32.963   4.301
## Average_of_TimeInPosition_Months_Contractor    -86.970     21.092  -4.123
## Average_of_TimeInPosition_Months_Employee     57.498     23.913   2.404
## Average_of_TimeToRetire_Years_Contractor       2.435       1.085   2.246
## Gender_Diversity_percent_Employee          216.159     56.786   3.807
## Indigenous_Employment_AU_percent_Contractor    23.244       3.989   5.828
## Indigenous_Employment_AU_percent_Employee     548.248    166.316   3.296
## In_position_less_than_2_Years_percent_Contractor    -25.553       8.433  -3.030
## Turnover_EIT_percent_Employee              86.735     23.250   3.731
##
##              Pr(>|t|)
## (Intercept)      0.450280
## Inclusion_Average    0.001967 **
## Average_of_TimeInBand_Months_Contractor    0.001323 **
## Average_of_TimeInBand_Months_Employee    0.000732 ***
## Average_of_TimeInPosition_Months_Contractor    0.001034 **
## Average_of_TimeInPosition_Months_Employee    0.030608 *
## Average_of_TimeToRetire_Years_Contractor    0.041396 *
## Gender_Diversity_percent_Employee    0.001926 **
## Indigenous_Employment_AU_percent_Contractor    4.39e-05 ***
## Indigenous_Employment_AU_percent_Employee    0.005300 **
## In_position_less_than_2_Years_percent_Contractor    0.008996 **
## Turnover_EIT_percent_Employee    0.002238 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 29.14 on 14 degrees of freedom
## (21 observations deleted due to missingness)
## Multiple R-squared:  0.9568, Adjusted R-squared:  0.9229
## F-statistic: 28.21 on 11 and 14 DF,  p-value: 1.22e-07
```

## Iron Ore

### Full Model

```
##
## Call:
## lm(formula = CuEqk ~ Average_of_TimeInBand_Months_Employee +
##   In_band_less_than_2_Years_percent_Employee + Average_of_TimeInPosition_Months_Contractor +
##   In_position_less_than_2_Years_percent_Contractor + Average_of_TimeInPosition_Months_Employee +
##   Indigenous_Employment_AU_percent_Contractor + In_position_less_than_2_Years_percent_Employee +
##   Sum_of_Separation_Count_Contractor + Turnover_EIT_percent_Employee +
##   Turnover_RTT_percent_Contractor + Unplanned_Absence_Rate_percent_Employee,
##   data = .)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -39.33 -12.61   1.62   10.87   35.69
##
## Coefficients:
##              Estimate Std. Error t value
## (Intercept)    30987.2212    3866.2113   8.015
## Average_of_TimeInBand_Months_Employee    -153.9306     33.5391  -4.590
## In_band_less_than_2_Years_percent_Employee    -101.3702     19.3439  -5.240
## Average_of_TimeInPosition_Months_Contractor    -67.3711     19.5673  -3.443
## In_position_less_than_2_Years_percent_Contractor    -27.9666      8.2795  -3.378
## Average_of_TimeInPosition_Months_Employee    -287.3245     71.4108  -4.024
## Indigenous_Employment_AU_percent_Contractor    -142.3368     35.4653  -4.013
## In_position_less_than_2_Years_percent_Employee    -55.9247     22.9966  -2.432
## Sum_of_Separation_Count_Contractor       2.7047       0.1988  13.604
## Turnover_EIT_percent_Employee    -122.8958     24.7344  -4.969
## Turnover_RTT_percent_Contractor    -139.6362     16.9963  -8.216
## Unplanned_Absence_Rate_percent_Employee     36.5887     10.6446   3.437
##
##              Pr(>|t|)
## (Intercept)      1.34e-06 ***
## Average_of_TimeInBand_Months_Employee    0.000421 ***
## In_band_less_than_2_Years_percent_Employee    0.000125 ***
## Average_of_TimeInPosition_Months_Contractor    0.003959 **
## In_position_less_than_2_Years_percent_Contractor    0.004508 **
## Average_of_TimeInPosition_Months_Employee    0.001257 **
## Indigenous_Employment_AU_percent_Contractor    0.001282 **
## In_position_less_than_2_Years_percent_Employee    0.029038 *
## Sum_of_Separation_Count_Contractor    1.84e-09 ***
## Turnover_EIT_percent_Employee    0.000206 ***
## Turnover_RTT_percent_Contractor    1.00e-06 ***
## Unplanned_Absence_Rate_percent_Employee    0.004005 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 24.13 on 14 degrees of freedom
## (21 observations deleted due to missingness)
## Multiple R-squared:  0.9855, Adjusted R-squared:  0.9741
## F-statistic: 86.56 on 11 and 14 DF,  p-value: 6.569e-11
```

### Reduced Model

```
##
## Call:
## lm(formula = CuEqk ~ Gender_Diversity_percent_Employee + Indigenous_Employment_AU_percent_Contractor +
##   Indigenous_Employment_AU_percent_Employee + In_band_less_than_2_Years_percent_Contractor,
```

```
## data = .)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -167.662  -39.571   8.527  45.627 162.149
##
## Coefficients:
##              Estimate Std. Error t value
## (Intercept)      5841.081    659.135   8.862
## Gender_Diversity_percent_Employee      -62.806    27.536  -2.281
## Indigenous_Employment_AU_percent_Contractor      14.509    18.695   0.776
## Indigenous_Employment_AU_percent_Employee     -230.105    37.665  -6.109
## In_band_less_than_2_Years_percent_Contractor      4.097     1.425   2.876
##
##              Pr(>|t|)
## (Intercept)      3.64e-11 ***
## Gender_Diversity_percent_Employee      0.0277 *
## Indigenous_Employment_AU_percent_Contractor      0.4421
## Indigenous_Employment_AU_percent_Employee     2.77e-07 ***
## In_band_less_than_2_Years_percent_Contractor      0.0063 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 67.69 on 42 degrees of freedom
## Multiple R-squared:  0.7245, Adjusted R-squared:  0.6983
## F-statistic: 27.61 on 4 and 42 DF,  p-value: 2.832e-11
```

## Copper

```
##
## Call:
## lm(formula = CuEqk ~ Sum_of_FTE_Employee + Sum_of_Headcount_Woman_Contractor +
##   Average_of_TimeInRio_Months_Contractor + Average_of_TimeInRio_Months_Employee +
##   Average_of_TimeInPosition_Months_Contractor + Gender_Diversity_percent_Employee +
##   Indigenous_Employment_AU_percent_Employee + In_band_less_than_2_Years_percent_Employee +
##   Sum_of_Separation_Count_Employee, data = .)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -62.698 -11.617  -2.116  18.521  47.632
##
## Coefficients:
##              Estimate Std. Error t value
## (Intercept)     -797.2843    1046.9662  -0.762
## Sum_of_FTE_Employee      -2.5830     0.5892  -4.384
## Sum_of_Headcount_Woman_Contractor      10.9686     3.0551   3.590
## Average_of_TimeInRio_Months_Contractor     128.8300    27.9423   4.614
## Average_of_TimeInRio_Months_Employee     -18.4843    10.4539  -1.768
## Average_of_TimeInPosition_Months_Contractor    -60.9608    23.0891  -2.640
## Gender_Diversity_percent_Employee     -75.7327    31.6317  -2.394
## Indigenous_Employment_AU_percent_Employee    8792.8036   2397.5315   3.667
## In_band_less_than_2_Years_percent_Employee    328.5612    66.5428   4.938
## Sum_of_Separation_Count_Employee       7.2000     1.5128   4.759
##
##              Pr(>|t|)
## (Intercept)      0.457426
## Sum_of_FTE_Employee      0.000462 ***
## Sum_of_Headcount_Woman_Contractor      0.002449 **
## Average_of_TimeInRio_Months_Contractor      0.000287 ***
## Average_of_TimeInRio_Months_Employee      0.096091
## Average_of_TimeInPosition_Months_Contractor      0.017820 *
## Gender_Diversity_percent_Employee      0.029255 *
## Indigenous_Employment_AU_percent_Employee      0.002081 **
## In_band_less_than_2_Years_percent_Employee      0.000148 ***
## Sum_of_Separation_Count_Employee      0.000213 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 30.92 on 16 degrees of freedom
## (21 observations deleted due to missingness)
## Multiple R-squared:  0.9147, Adjusted R-squared:  0.8667
## F-statistic: 19.07 on 9 and 16 DF,  p-value: 6.198e-07
```

## Minerals

```
##
## Call:
## lm(formula = CuEqk ~ Sum_of_Headcount_Employee + Sum_of_Headcount_Woman_Contractor +
##   Indigenous_Employment_AU_percent_Employee + Planned_Absence_Rate_percent_Employee +
##   In_position_less_than_2_Years_percent_Contractor + In_position_less_than_2_Years_percent_Employee,
##   data = .)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -21.4939  -4.8877  -0.6839   6.6024  13.8581
##
## Coefficients:
##              Estimate Std. Error t value
## (Intercept)     1054.19188    134.69592   7.826
## Sum_of_Headcount_Employee      -0.10288     0.02261  -4.550
## Sum_of_Headcount_Woman_Contractor      1.68916     0.64131   2.634
## Indigenous_Employment_AU_percent_Employee     99.96899    16.21788   6.164
## Planned_Absence_Rate_percent_Employee      1.33014     0.63171   2.106
## In_position_less_than_2_Years_percent_Contractor    -1.66318     0.40482  -4.108
## In_position_less_than_2_Years_percent_Employee     12.90331     2.17721   5.927
##
##              Pr(>|t|)
## (Intercept)      4.14e-09 ***
## Sum_of_Headcount_Employee      6.52e-05 ***
## Sum_of_Headcount_Woman_Contractor      0.012613 *
## Indigenous_Employment_AU_percent_Employee      5.28e-07 ***
## Planned_Absence_Rate_percent_Employee      0.042699 *
```

```
## In_position_less_than_2_Years_percent_Contractor 0.000237 ***
## In_position_less_than_2_Years_percent_Employee 1.07e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.548 on 34 degrees of freedom
## (6 observations deleted due to missingness)
## Multiple R-squared:  0.7217, Adjusted R-squared:  0.6726
## F-statistic: 14.69 on 6 and 34 DF, p-value: 3.352e-08
```

## Opportunities

- Though using the MPR dashboard's data model meant a lower investment data extract, the lack of certain variables (columns/features) and the presence of missing values (less historical data) mean there is potential improvement in using HR Lakehouse data in future.