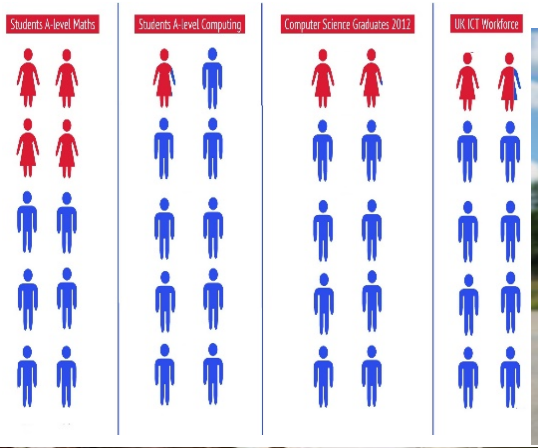
Education for Global Leadership through STEM

(Science, Technology, Engineering & Math)



Atlassian

FISHBURNERS
EMPOWERING TECH ENTREPRENEURS

1. Identify the Problem
2. Obtain the Data
3. Understand the Data
4. Prepare the Data
5. Analyze the Data
6. Presenting the Results

"[Science]"[Science] is more than a school subject, or a periodic table, or the properties of waves. It is **an approach to the world**, and then have **the capacity to change the world**…"

-- President Barack Obama March 23,2015

Question:

Can you guess how many **females** were enrolled in the **Masters of Data Science** cohort at the University of Technology, Sydney (UTS) this year?

a. 20
b. 8
c. 15
d. 3

Student enrolment background :

- **Females**: graphic designer, lawyer, marketing manager, mathematician, computer programmer (2), digital applications and analyst.
  - 4 STEM (3 current + 1 drop-out)
- **Males**: Genomics, computer programmers, business analyst, engineer, lecturer, political scientist, data analytics and business strategy.

"One of the things that I really strongly believe in is that **we need to have more girls interested in math, science, and engineering.** We've got half the population that is way underrepresented in those fields and that means that we've got a whole bunch of talent…not being encouraged the way they need to."

-- President Barack Obama February 2013

1. Identify the Problem

Research Question

We believe that that the national student graduation rate in STEM coursework for both men and women has declined over time. We are examining a number of key national variables: such as student enrolment rates, parent's occupation and student confidence levels in maths and science to determine if it supports the claim.

Hypothesize goals

Null Hypothesis: H0: Bi=0

In a regression where the STEM enrolment rate is the dependent variable and parent's occupation is the independent variable, the coefficient on [enrolment rate] is equal to 0.

- Predictor xi [parent's occupation] has no significant effect on the response [enrolment], after controlling for other predictors in the model.

Alternative Hypothesis: H1: Bi does not equal 0

In a regression where the STEM enrolment rate is the dependent variable and [enrolment rate] is the independent variable, the coefficient on [enrolment rate] is equal to 0.

- We reject the null hypothesis and accept the alternative hypothesis.
- Predictor xi [parent's STEM occupation] has a significant effect on the response [STEM enrolment], after controlling for other predictors in the model.

1. Identify the Problem

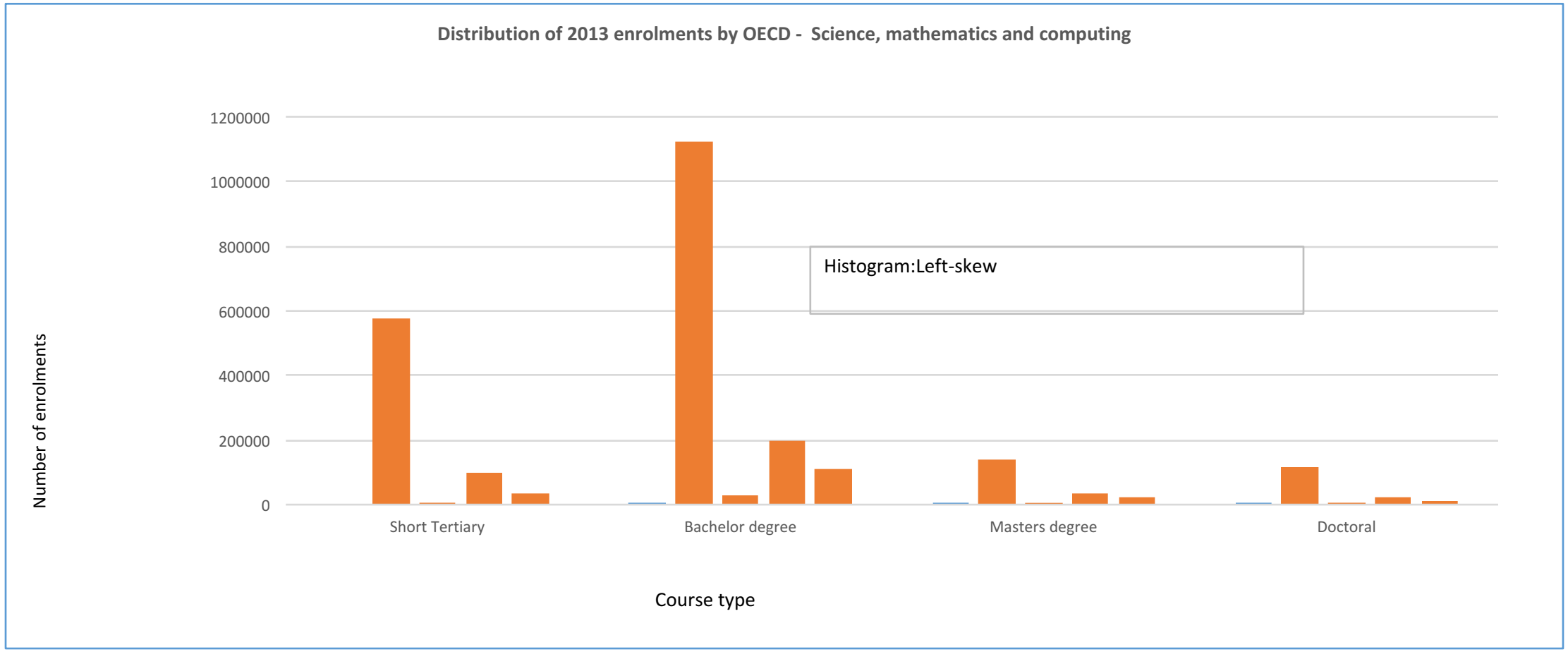
Exploratory Analysis Questions

- Which country produced the highest number of STEM graduates?
- Which country produced the lowest number of STEM graduates?
- What are the average earnings of STEM graduates in Australia compared to the OECD average for both males and females?
- How is Australia positioned to compete on a global scale in terms of innovation?
- Which STEM courses have the lowest and highest representation of females?
- How much more do STEM graduates earn on average compared to non-STEM graduates?
- Is there a global trend in the decline in female STEM course work graduates?
- Should females pursue a STEM career and why?
- Where are the Top 10 countries with greatest number of STEM graduates?
- Where are the Bottom 10 countries with the lowest number of STEM graduates?
- Which country should females pursue a STEM career?

2. Obtain the Data

- Data Source: Data was identified and exported from the **OECD website**
- Field of Study: Social Science – includes behavioural data
- Sample period:
  - Demographic data across OECD countries from 2005 to 2012
  - Enrolment data 2013
- Exported data was combined and joined into an Excel spreadsheet
- Data: was collated based on the criteria for selecting only the following STEM subjects:
  - Science
  - Life Science
  - Physical Science
  - Computing
  - Maths & Statistics
  - Engineering, Construction and Manufacturing
  - Engineering and Engineering Trades
- OECD countries: Unique identifier or primary key joining all predictor variables.
- Missing values: YES
- Data Types: Numerical and categorical
- 90 observations for two segments – engineering & science and maths

Science ,Maths,Computing – number of enrolments



4.Prepare the Data

- There were 45 countries sampled including OECD and Non-OECD
- Data was combined across different common time periods
- It was a limitation that multiple missing values wereimputed with the averages of the column
- The STEM data was not available for some countries

Parent's in STEM occupations

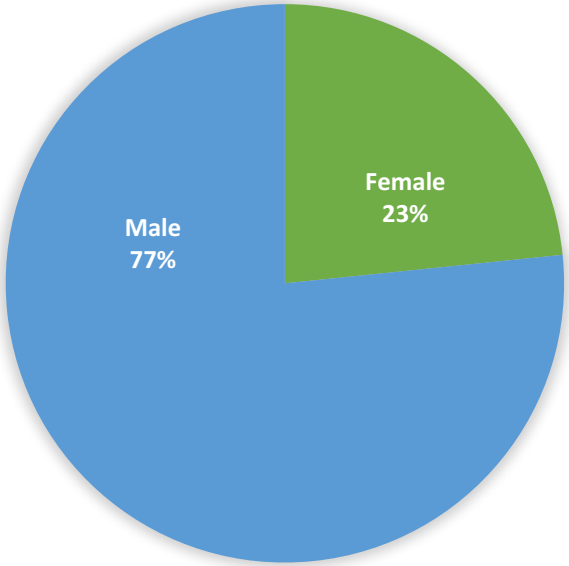
Father

- Saudi Arabia 13%
- Iceland 14.4 %

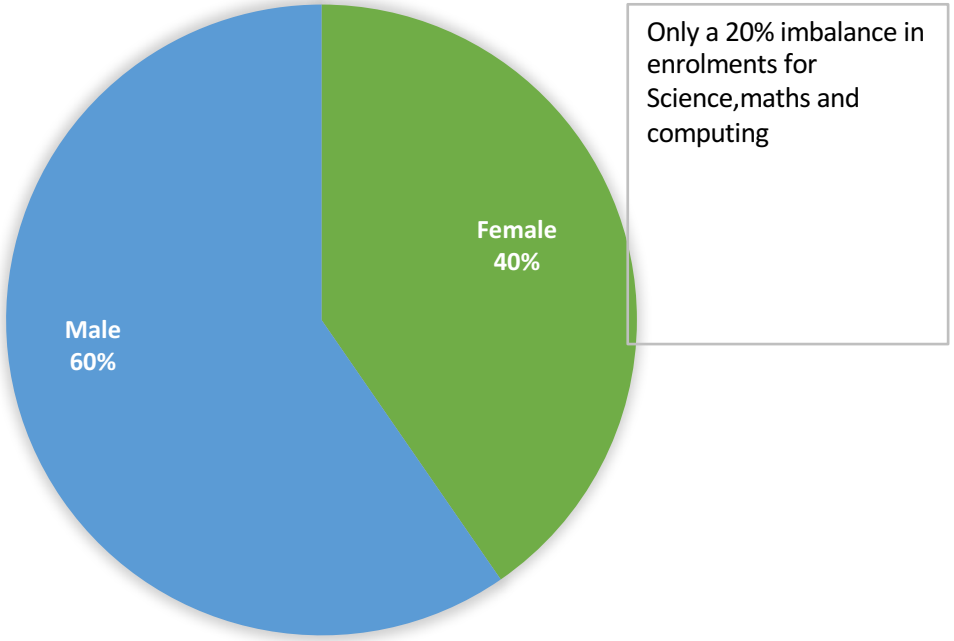
- Mother
- Israel 5%
- Denmark 4.7 %

Gender imbalance -enrolments

% OECD GENDER IMBALANCE IN ENGINEERING, MANUFACTURING AND CONSTRUCTION ENROLMENT IN 2013



OECD GENDER IMBALANCE IN SCIENCE, MATHEMATICS AND COMPUTING ENROLMENTS IN 2013

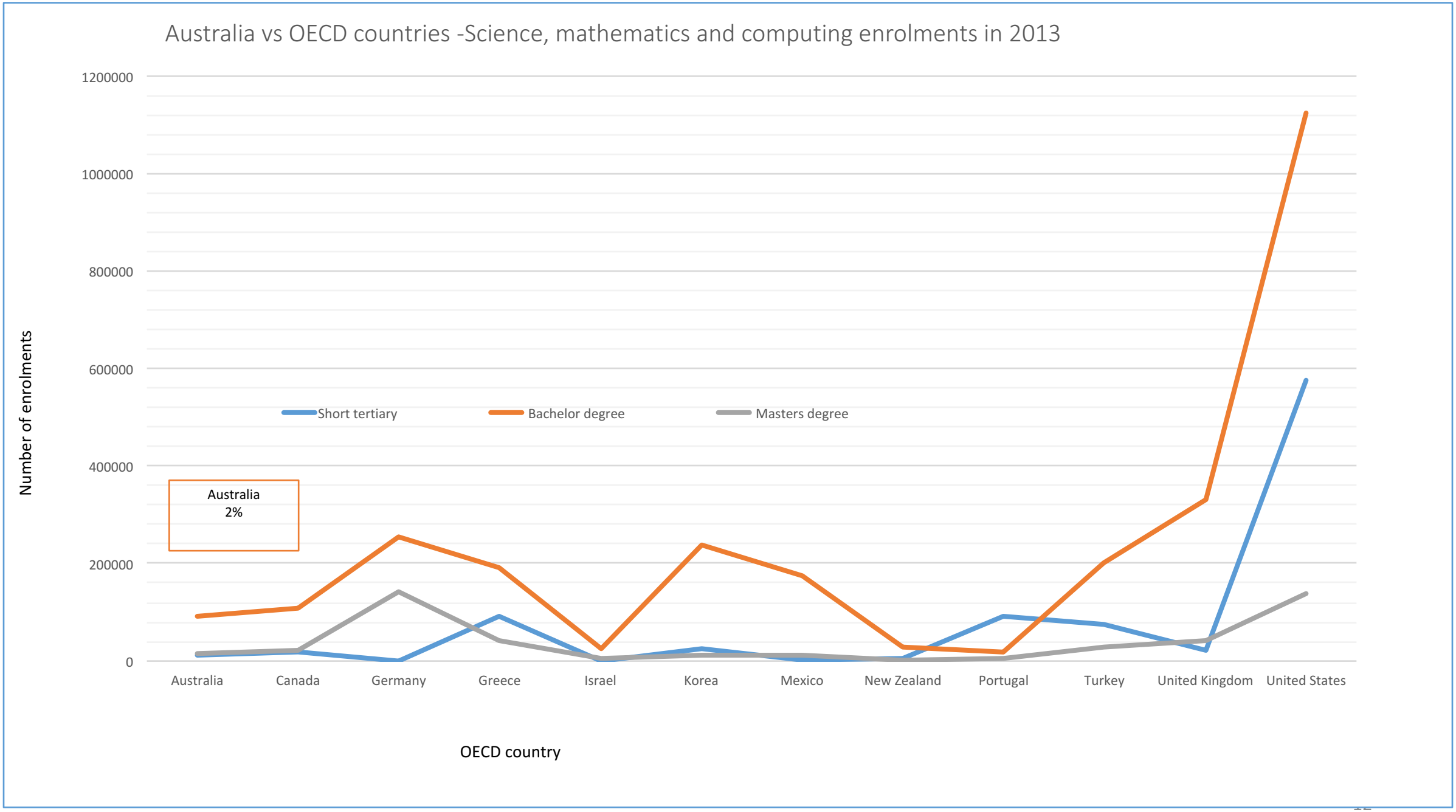


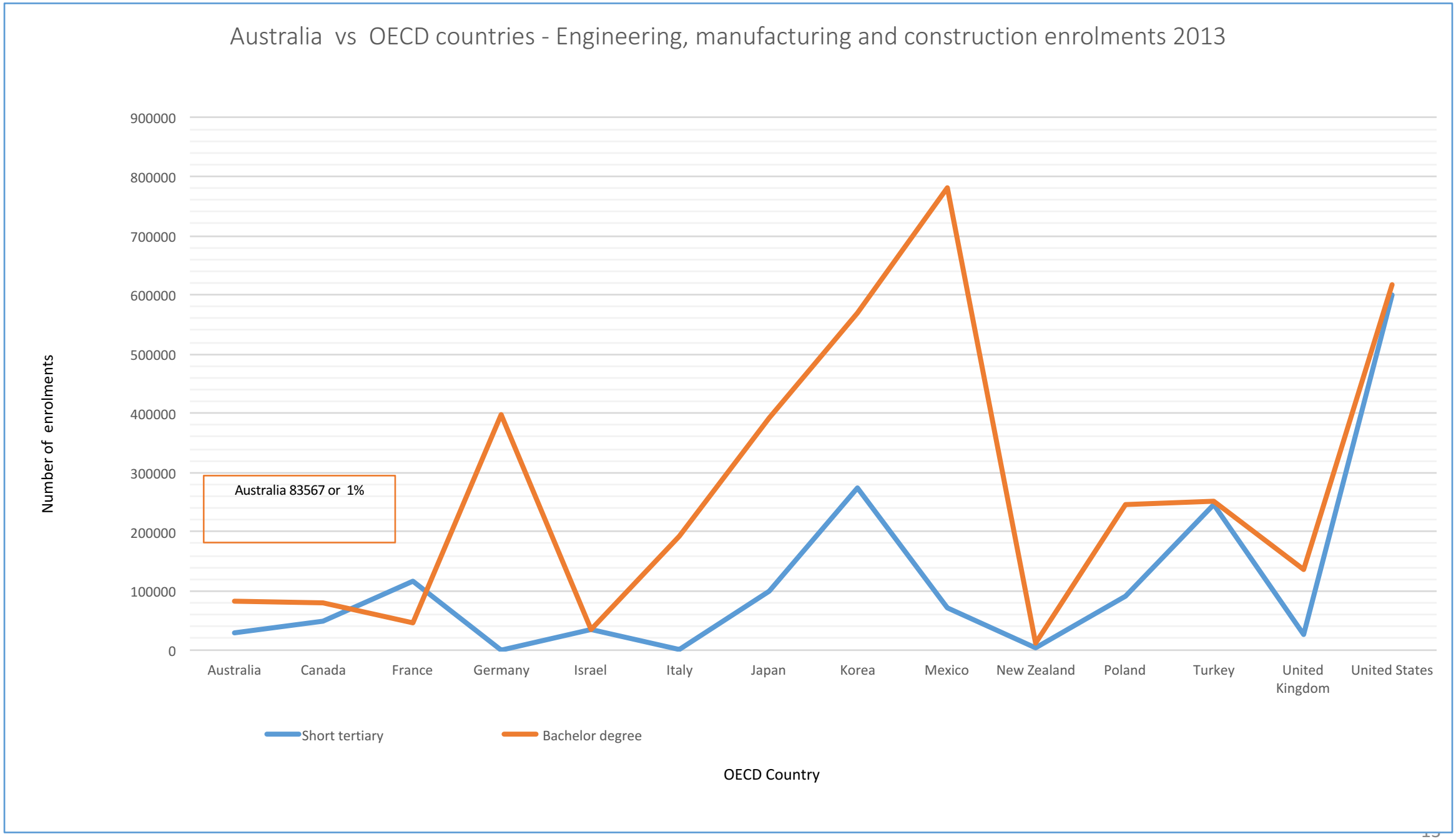
Gender imbalance -enrolments

OECD Engineering, manufacturing and construction enrolment	Gender Gaps					
Gender	Bachelor Degree (%)	Masters degree (%)	Doctoral or PhD (%)	Short Tertiary (%)	Grand Total	% Grand Total
Female	23%	30%	25%	20%	1924136	23%
Male	77%	70%	75%	80%	6308903	77%
% Difference:	54%	41%	50%	59%	4384767	53%
Grand Total:	4774422	1090563	248727	2119327	8233039	

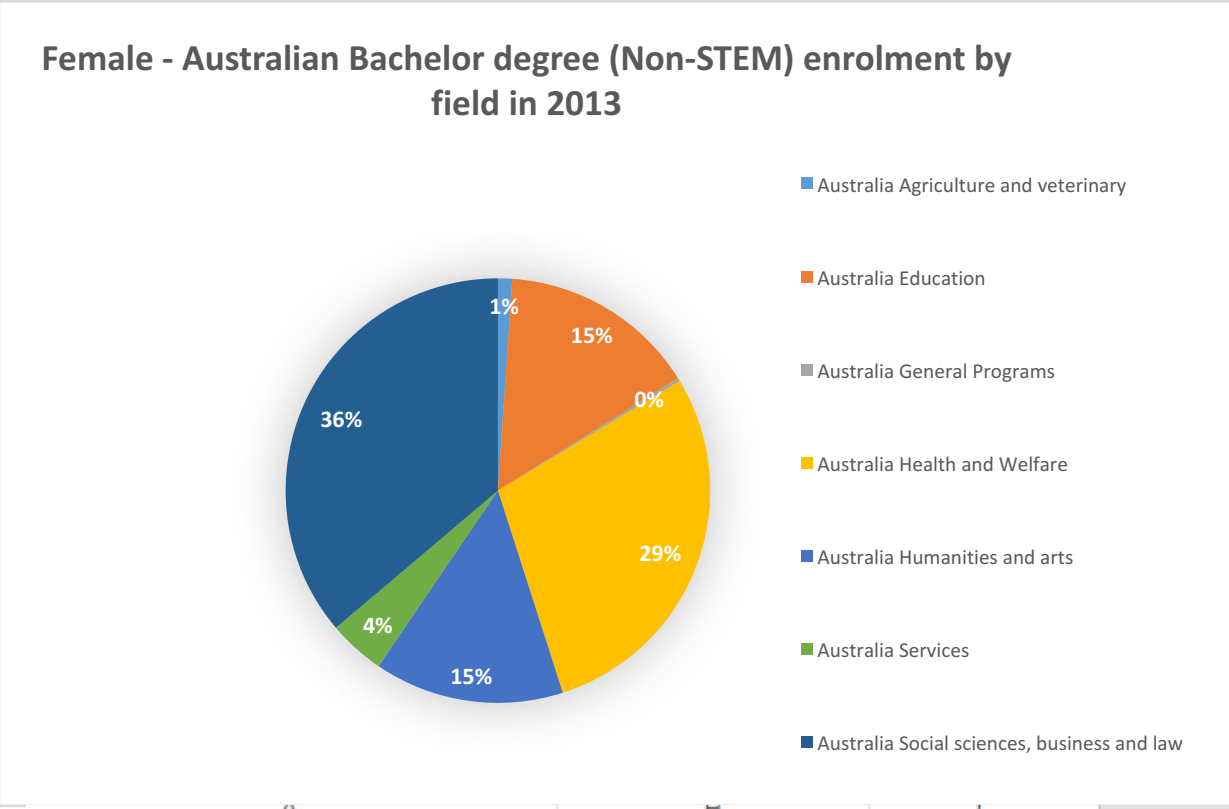
OECD Science, mathematics and computing	Gender Gaps					
Gender	Bachelor Degree (%)	Masters degree (%)	Doctoral or PhD (%)	Short Tertiary (%)	Grand Total	% Grand Total
Female	41%	42%	40%	38%	2416024	40%
Male	59%	58%	60%	62%	3567166	60%
% Difference:	18%	15%	19%	25%	1151142	20%
Grand Total:	3669853	746878	369995	1196464	5983190	

Note: only a 20% gender imbalance in total coursework enrolments in 2013 for science,mathematics and computing


Australia vs OECD countries -Science, mathematics and computing enrolments in 2013
1200000
1000000
800000
600000
400000
200000
0
Number of enrolments
Short tertiary
Bachelor degree
Masters degree
Australia
2%
Australia
Canada
Germany
Greece
Israel
Korea
Mexico
New Zealand
Portugal
Turkey
United Kingdom
United States
OECD country

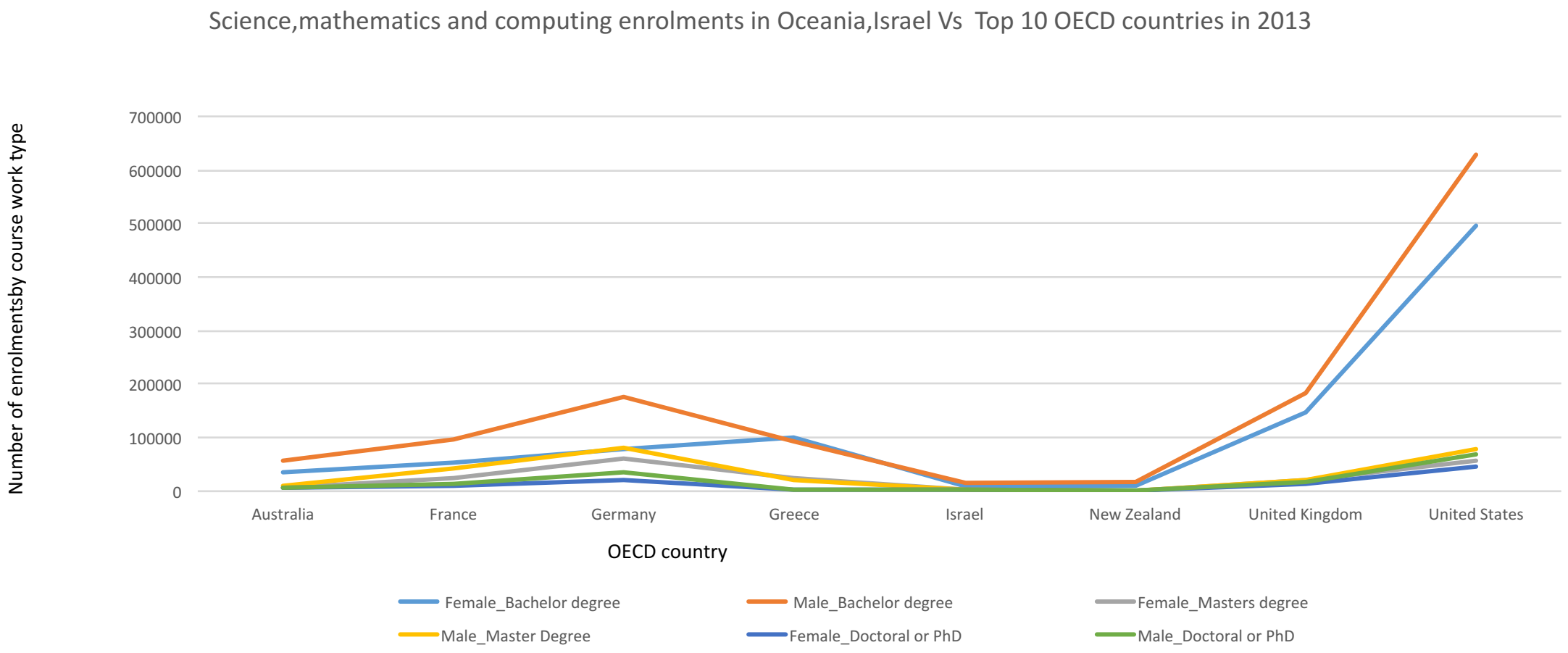

Australia vs OECD countries - Engineering, manufacturing and construction enrolments 2013
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
Number of enrolments
Australia 83567 or 1%
Australia
Canada
France
Germany
Israel
Italy
Japan
Korea
Mexico
New Zealand
Poland
Turkey
United Kingdom
United States
Short tertiary
Bachelor degree
OECD Country

Trends & Insights –Non - STEM



Field of Enrolment (Non-STEM) - Female	Bachelor Degree	Masters Degree	Doctoral Degree	Short Tertiary
Australia	465423	101058	20138	124631
Agriculture and veterinary	5045	974	1066	1314
Education	69941	17325	2522	1559
General Programs	1166	124	6	348
Health and Welfare	133556	23799	5732	52726
Humanities and arts	67264	7615	3257	13403
Services	20034	2399	793	5080
Social sciences, business and law	168417	48822	6762	50201
Grand Total	**465423**	**101058**	**20138**	**124631**

5. Trends & Insights



6.Presenting the Results

- Bias – enrolment data available for 2013 and historical data in percentages
- Sample bias –two sub groups of male and female is a small sample size.

Limitations:

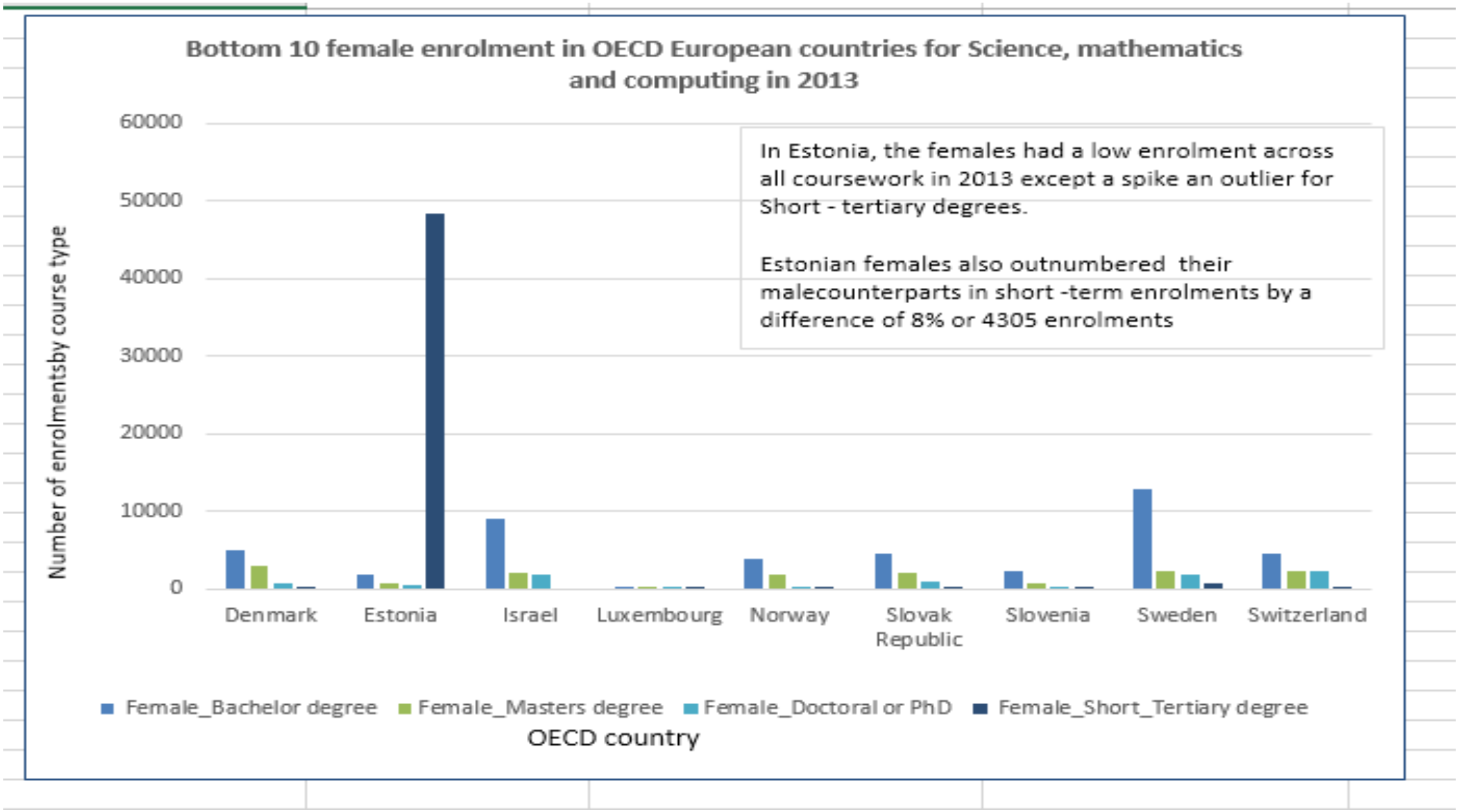
-Limited comparable data from the OECD for enrolments , datafor graduation

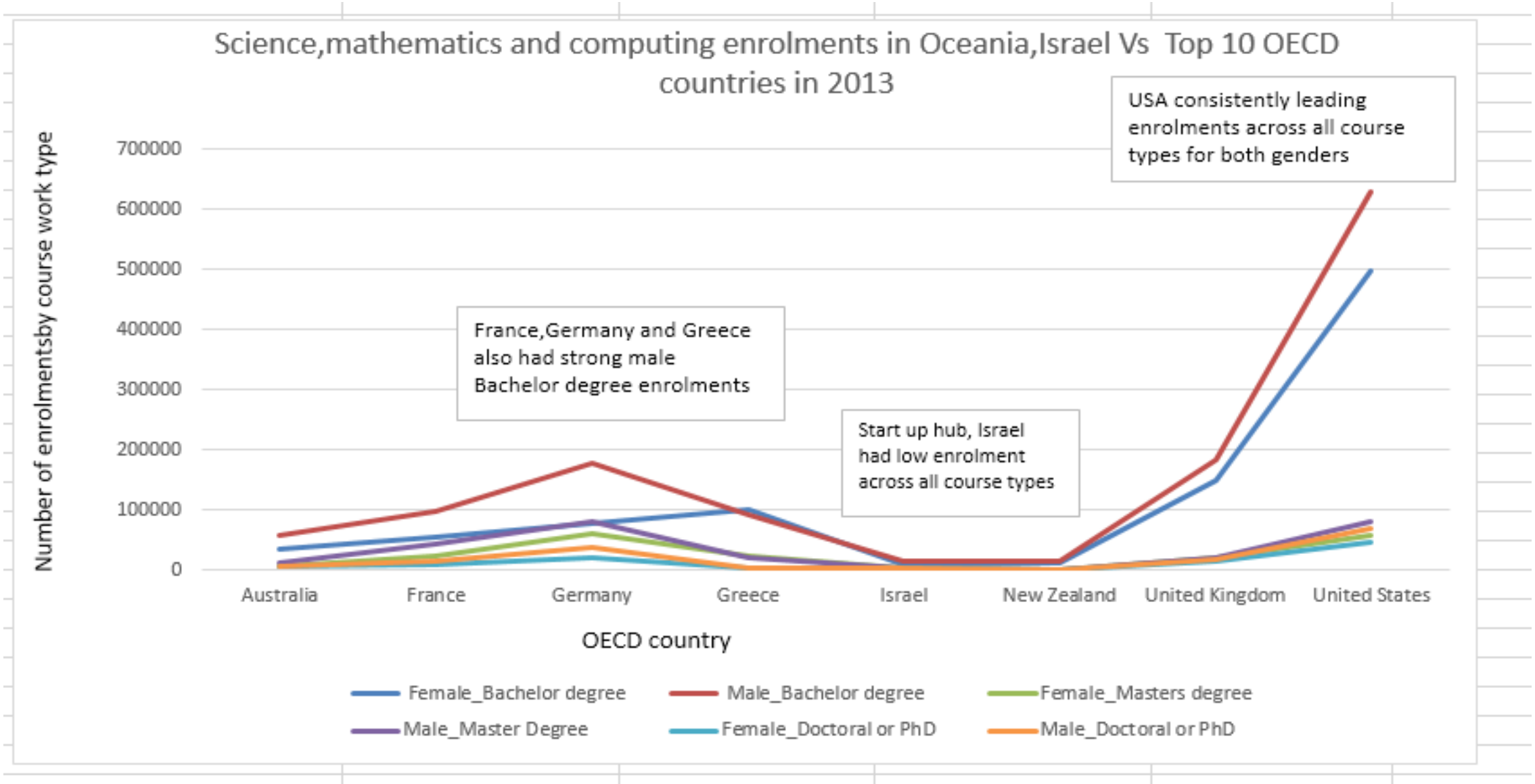
Ordinary Least Squares (OLS) – Linear Regression

Linear Regression Assumptions:

- The Outcome variable (Y) or dependent variable is continuous with an infinite range
- The errors are independent and identically distributed with a **normal distribution** around zero.

- Limitations
- Prediction models was problematic because there were multiple variables including different policies in different countries and STEM data was measured at a country level and not individual level.


Bottom 10 female enrolment in OECD European countries for Science, mathematics and computing in 2013
In Estonia, the females had a low enrolment across all coursework in 2013 except a spike an outlier for Short - tertiary degrees.
Estonian females also outnumbered their malecounterparts in short -term enrolments by a difference of 8% or 4305 enrolments
Number of enrolmentsby course type
60000
50000
40000
30000
20000
10000
0
Denmark
Estonia
Israel
Luxembourg
Norway
Slovak Republic
Slovenia
Sweden
Switzerland
Female_Bachelor degree
Female_Masters degree
Female_Doctoral or PhD
Female_Short_Tertiary degree
OECD country


Science,mathematics and computing enrolments in Oceania,Israel Vs Top 10 OECD countries in 2013
USA consistently leading enrolments across all course types for both genders
France,Germany and Greece also had strong male Bachelor degree enrolments
Start up hub, Israel had low enrolment across all course types
Number of enrolmentsby course work type
700000
600000
500000
400000
300000
200000
100000
0
Australia
France
Germany
Greece
Israel
New Zealand
United Kingdom
United States
OECD country
Female_Bachelor degree
Male_Bachelor degree
Female_Masters degree
Male_Master Degree
Female_Doctoral or PhD
Male_Doctoral or PhD

Recommendation 1

- Malcolm Turnbull innovation statement released 7th December
- Funding for Universities
- Funding for women in STEM education $13million
- Coding for children years 5 to 7
- CSIRO

Q & A?