Higher Education Students Performance Evaluation

Scope

Do an exploratory data analysis on the HE Students Performance Evaluation dataset.

- Understand the overall data
- Do some basic cleaning and rename the columns
- Plot and gather insights

Summary

Dropped a column `Student ID` and renamed the columns. Checked for missing values and then saved the data as parquet file.

Personal

- Majority of the students (35) had grade DD followed by around 32 students who had maximum grade of AA. Less than 10 students out of 145 students failed.
- Gender and Age :- There are more male students and they have significantly higher grades than female students. Majority of the students are under the age 26.
- Students graduated from private high school had the highest grades.
- Most students had recieved atleast 50% scholarship, although there was no linear correlation between scholarship type and grades.
- Most students did not do any additional work and had salary of USD 135-200. The students who did not do any work and the lowest salary band had the highest grades.
- Students who were active in sports or arts tend to do slightly better in academics.
- Most students took buses and lived in rental houses or dormitories. Students who cycles had below average grades but the accomodation of students did not affect their grades.

Family

- Students whose father had higher educational level tends to have higher grades. There was no such trend for mother's.
- The parents tend to marry between people with same educational level. There were some cases where father had more educaction than mother's but very few cases the other way around.

Educational Habits

- Half of the students studied Course 1. Students from Course 3 and 7 had the very high grade on average whereas the students from Course 1, 8 and 9 had very poor grades.
- Expected CPGA of students is positively correlated with the actual grades they get.

Due to time constraints, I could not do a complete EDA.

Imports

In [1]:
```
import sys

import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import altair as alt
```

In [2]:
```
print(f'pandas:{pd.__version__}')
print(f'seaborn:{sns.__version__}')
print(f'altair:{alt.__version__}')
print(f'python:{sys.version}')
```

```
pandas:2.0.1
seaborn:0.12.2
altair:5.0.0
python:3.9.16 (main, Mar  8 2023, 10:39:24) [MSC v.1916 64 bit (AMD64)]
```

Path

Change the BASE path to your folder location

In [3]:
```
BASE = r"C:\\Users\\anand\\Documents\\HE_Performance_3b"

PATH = BASE + r"\\data\\raw\\"

EXPORT = BASE + r"\\data\\processed\\"
```

Read Data

In [4]:
```
# Read excel
df = pd.read_csv(PATH + r"DATA.csv", sep = ';')

# Preview
df.head(10)
```

Out[4]:

	STUDENT ID	1	2	3	4	5	6	7	8	9	...	23	24	25	26	27	28	29	30	COURSE ID	GRADE
0	STUDENT1	2	2	3	3	1	2	2	1	1	...	1	1	3	2	1	2	1	1	1	1
1	STUDENT2	2	2	3	3	1	2	2	1	1	...	1	1	3	2	3	2	2	3	1	1
2	STUDENT3	2	2	2	3	2	2	2	2	4	...	1	1	2	2	1	1	2	2	1	1
3	STUDENT4	1	1	1	3	1	2	1	2	1	...	1	2	3	2	2	1	3	2	1	1
4	STUDENT5	2	2	1	3	2	2	1	3	1	...	2	1	2	2	2	1	2	2	1	1
5	STUDENT6	2	2	2	3	2	2	2	2	1	...	1	1	1	2	1	2	4	4	1	2
6	STUDENT7	1	2	2	4	2	2	2	1	1	...	1	1	3	3	3	3	4	4	1	5
7	STUDENT8	1	1	2	3	1	1	1	2	2	...	3	1	3	2	2	1	1	1	1	2
8	STUDENT9	2	1	3	3	2	1	1	1	1	...	1	1	3	2	2	2	4	3	1	5
9	STUDENT10	2	1	2	3	2	2	1	3	4	...	1	1	2	2	2	2	1	2	1	0

10 rows × 33 columns

In [5]:
```
# Shape of data
df.shape
```

Out[5]:
```
(145, 33)
```

In [6]:
```
# Preview columns
df.head().T
```

Out[6]:

	0	1	2	3	4
STUDENT ID	STUDENT1	STUDENT2	STUDENT3	STUDENT4	STUDENT5
1	2	2	2	1	2
2	2	2	2	1	2
3	3	3	2	1	1
4	3	3	3	3	3
5	1	1	2	1	2
6	2	2	2	2	2
7	2	2	2	1	1
8	1	1	2	2	3
9	1	1	4	1	1
10	1	1	2	2	4
11	1	2	2	1	3
12	2	3	2	2	3
13	3	2	2	5	2
14	1	1	1	1	1
15	2	2	2	2	2
16	5	1	1	1	4
17	3	2	2	3	2
18	2	2	1	1	1
19	2	2	2	2	1
20	1	1	1	1	1
21	1	1	1	1	1
22	1	1	1	1	1
23	1	1	1	1	2
24	1	1	1	2	1
25	3	3	2	3	2
26	2	2	2	2	2
27	1	3	1	2	2
28	2	2	1	1	1

	0	1	2	3	4
29	1	2	2	3	2
30	1	3	2	2	2
COURSE ID	1	1	1	1	1
GRADE	1	1	1	1	1

In [7]:
```
# Drop Student id column
df = df.drop('STUDENT ID', axis =1)

# Preview
df.head()
```

Out[7]:

	1	2	3	4	5	6	7	8	9	10	...	23	24	25	26	27	28	29	30	COURSE ID	GRADE
0	2	2	3	3	1	2	2	1	1	1	...	1	1	3	2	1	2	1	1	1	1
1	2	2	3	3	1	2	2	1	1	1	...	1	1	3	2	3	2	2	3	1	1
2	2	2	2	3	2	2	2	2	4	2	...	1	1	2	2	1	1	2	2	1	1
3	1	1	1	3	1	2	1	2	1	2	...	1	2	3	2	2	1	3	2	1	1
4	2	2	1	3	2	2	1	3	1	4	...	2	1	2	2	2	1	2	2	1	1

5 rows × 32 columns

In [8]:
```
# Mean and quantiles
df.describe().T
```

Out[8]:

	count	mean	std	min	25%	50%	75%	max
1	145.0	1.620690	0.613154	1.0	1.0	2.0	2.0	3.0
2	145.0	1.600000	0.491596	1.0	1.0	2.0	2.0	2.0
3	145.0	1.944828	0.537216	1.0	2.0	2.0	2.0	3.0
4	145.0	3.572414	0.805750	1.0	3.0	3.0	4.0	5.0
5	145.0	1.662069	0.474644	1.0	1.0	2.0	2.0	2.0
6	145.0	1.600000	0.491596	1.0	1.0	2.0	2.0	2.0
7	145.0	1.579310	0.495381	1.0	1.0	2.0	2.0	2.0
8	145.0	1.627586	1.020245	1.0	1.0	1.0	2.0	5.0
9	145.0	1.620690	1.061112	1.0	1.0	1.0	2.0	4.0
10	145.0	1.731034	0.783999	1.0	1.0	2.0	2.0	4.0
11	145.0	2.282759	1.223062	1.0	1.0	2.0	3.0	6.0
12	145.0	2.634483	1.147544	1.0	2.0	3.0	3.0	6.0
13	145.0	2.806897	1.360640	1.0	2.0	3.0	4.0	5.0
14	145.0	1.172414	0.490816	1.0	1.0	1.0	1.0	3.0
15	145.0	2.358621	0.805156	1.0	2.0	2.0	2.0	5.0
16	145.0	2.806897	1.329664	1.0	2.0	3.0	4.0	5.0

	count	mean	std	min	25%	50%	75%	max
17	145.0	2.200000	0.917424	1.0	2.0	2.0	3.0	5.0
18	145.0	1.944828	0.562476	1.0	2.0	2.0	2.0	3.0
19	145.0	2.013793	0.539884	1.0	2.0	2.0	2.0	3.0
20	145.0	1.213793	0.411404	1.0	1.0	1.0	1.0	2.0
21	145.0	1.206897	0.588035	1.0	1.0	1.0	1.0	3.0
22	145.0	1.241379	0.429403	1.0	1.0	1.0	1.0	2.0
23	145.0	1.337931	0.614870	1.0	1.0	1.0	2.0	3.0
24	145.0	1.165517	0.408483	1.0	1.0	1.0	1.0	3.0
25	145.0	2.544828	0.564940	1.0	2.0	3.0	3.0	3.0
26	145.0	2.055172	0.674736	1.0	2.0	2.0	3.0	3.0
27	145.0	2.393103	0.604343	1.0	2.0	2.0	3.0	3.0
28	145.0	1.806897	0.810492	1.0	1.0	2.0	2.0	3.0
29	145.0	3.124138	1.301083	1.0	2.0	3.0	4.0	5.0
30	145.0	2.724138	0.916536	1.0	2.0	3.0	3.0	4.0
COURSE ID	145.0	4.131034	3.260145	1.0	1.0	3.0	7.0	9.0
GRADE	145.0	3.227586	2.197678	0.0	1.0	3.0	5.0	7.0

In [9]:
```
# Check for null values
df.isna().any()
```

Out[9]:
```
1             False
2             False
3             False
4             False
5             False
6             False
7             False
8             False
9             False
10            False
11            False
12            False
13            False
14            False
15            False
16            False
17            False
18            False
19            False
20            False
21            False
22            False
23            False
24            False
25            False
26            False
27            False
28            False
29            False
30            False
```

```
COURSE ID     False
GRADE         False
dtype: bool
```

No null values

In [10]:

```
# Rename columns
df.columns = [
    'age',
    'sex',
    'grad_hs',
    'scholar_type',
    'add_work',
    'reg_art_sport',
    'partner',
    'total_salary',
    'transport_uni',
    'acc_type',
    'mother_edu',
    'father_edu',
    'siblings',
    'parental',
    'mother_occ',
    'father_occ',
    'weekly_study_hours',
    'rf_non_scientific',
    'rf_scientific',
    'attendance_seminar',
    'impact',
    'attendance_classes',
    'prep_friends',
    'prep_freq',
    'notes',
    'listening',
    'discussion',
    'flip-classroom',
    'cgpa_last_sem',
    'cgpa_expected',
    'course_id',
    'grade'
]

# Preview
df.head(1)
```

Out[10]:

	age	sex	grad_hs	scholar_type	add_work	reg_art_sport	partner	total_salary	transport_uni	acc_type	...	prep
0	2	2	3	3	1	2	2	1	1	1	...	

1 rows × 32 columns

EDA

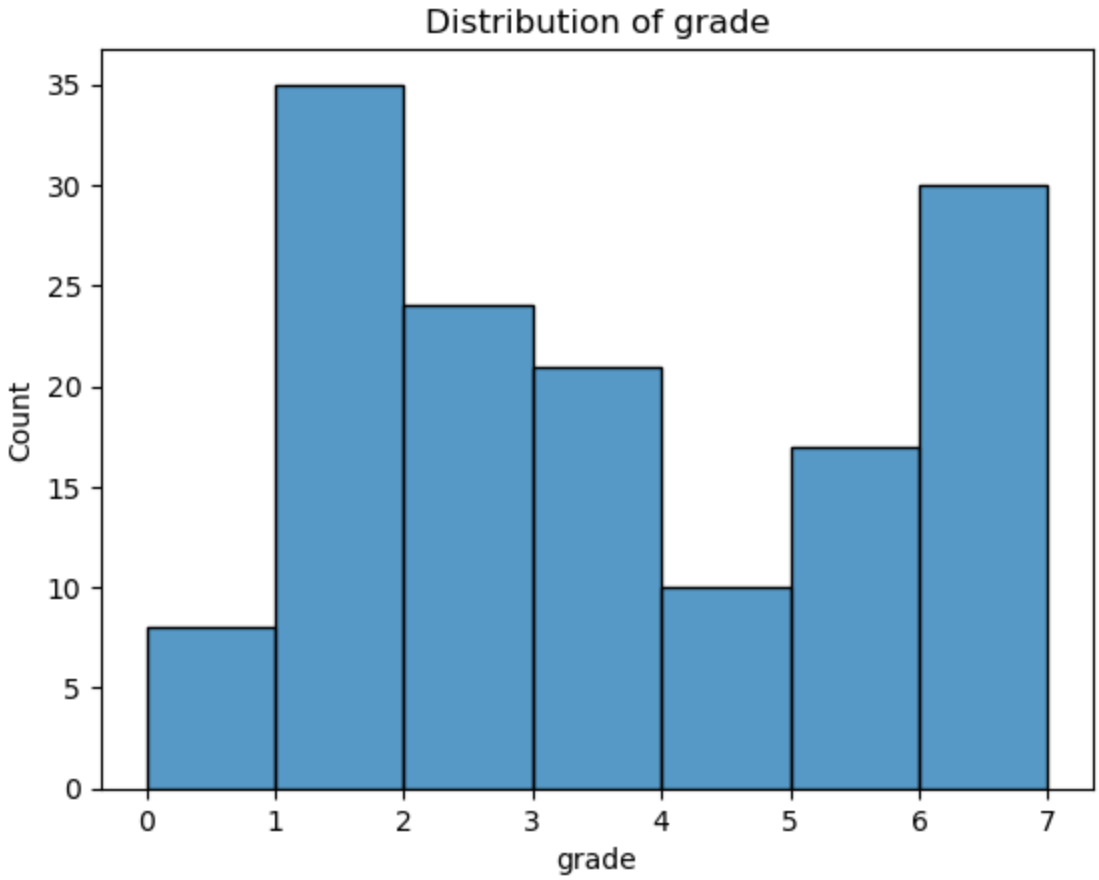
Personal

Grade

In [11]:

```
# Distribution of grade
sns.histplot(df.grade, bins = 7).set_title('Distribution of grade')
```

Out[11]:
```
Text(0.5, 1.0, 'Distribution of grade')
```



Majority of the students (35) had grade DD followed by around 32 students who had maximum grade of AA. Less than 10 students out of 145 students failed.

In [12]:
```
# Average grade
df.grade.mean()
```

Out[12]:
```
3.2275862068965515
```

Gender and Age

In [13]:
```
# Count of males and females
df.sex.value_counts()
```

Out[13]:
```
sex
2    87
1    58
Name: count, dtype: int64
```

There are more male students than female students.

In [14]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('sex:O',title = 'Gender'),
    y=alt.Y('mean(grade):Q', title='Average grade')
).properties(
    title = 'Average grade per Gender ',
    height=350,
    width=400
)
```

Out[14]:

Male students have significantly higher grades.

In [15]:
```
# Distribution of age group
df.age.value_counts()
```

Out[15]:
```
age
2    70
1    65
3    10
Name: count, dtype: int64
```

Majority of students are under 26

In [16]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('age:O',title = 'Age group'),
    y=alt.Y('mean(grade):Q', title='Average grade')
).properties(
    title = 'Average grade per Age group ',
    height=350,
    width=400
)
```

Out[16]:

Younger students tend to have higher grades on average with 26+ year olds have less than CB grade on average.

Graduated High school

In [17]:
```
# Distribution of graduated high school
df.grad_hs.value_counts()
```

Out[17]:
```
grad_hs
2    103
1     25
3     17
Name: count, dtype: int64
```

71% of students are from state schools.

In [18]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('grad_hs:O',title = 'Graduated high school type'),
    y=alt.Y('mean(grade):Q', title='Average grade'),
).properties(
    title = 'Average grade of per Graduated high school type ',
    height=350,
    width=400
)
```

Out[18]:

Private students performed the worst.

Scholarship type

In [19]:
```
# Distribution of scholarship type
```

```
df.scholar_type.value_counts()
```

Out[19]:
```
scholar_type
3    76
4    42
5    23
2     3
1     1
Name: count, dtype: int64
```

Almost all the students had atleast 50% scholarship with majority having full scholarship.

In [20]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('scholar_type:O',title = 'Scholarship type'),
    y=alt.Y('mean(grade):Q', title='Average grade'),
).properties(
    title = 'Average grade per Scholarship type ',
    height=350,
    width=400
)
```

Out[20]:

0% and 25% scholarship has too small sample size for the average grade to be reliable data.

Regular artistic or sports activity

In [21]:
```
# Distribution of regular artistic or sports activity
df.reg_art_sport.value_counts()
```

Out[21]:
```
reg_art_sport
2    87
1    58
Name: count, dtype: int64
```

Majority of students did not do arts or sports.

In [22]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('reg_art_sport:O',title = 'regular artistic or sports activity'),
    y=alt.Y('mean(grade):Q', title='Average grade'),
).properties(
    title = 'Average grade if they did Regular artistic or sports activity or not ',
    height=350,
    width=400
)
```

Out[22]:

Students who did arts or sports have slightly better grades.

Partner

In [23]:
```
# Distribution of partner or not
df.partner.value_counts()
```

Out[23]:
```
partner
2    84
1    61
Name: count, dtype: int64
```

More than half the students did not have partners.

In [24]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('partner:O',title = 'partner'),
    y=alt.Y('mean(grade):Q', title='Average grade'),
).properties(
    title = 'Average grade if they had Partner or not ',
    height=350,
    width=400
)
```

Out[24]:

Students who had partners have slightly better grades.

Total salary and Additional Work

In [25]:
```
# Distribution of additional work
df.add_work.value_counts()
```

Out[25]:
```
add_work
2    96
1    49
Name: count, dtype: int64
```

Majority of the students did not work.

Majority of students earned USD 135-200 whwereas very few people earned above USD 341.

In [26]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('add_work:O',title = 'Additional work'),
    y=alt.Y('mean(grade):Q', title='Average grade'),
).properties(
    title = 'Average grade if they did Additional work or not ',
    height=350,
    width=400
)
```

Out[26]:

Students who did not do additional work had higher grades.

In [27]:
```
# Distribution of total salary
df.total_salary.value_counts()
```

Out[27]:
```
total_salary
1    93
2    27
3    16
5     5
4     4
Name: count, dtype: int64
```

In [28]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('total_salary:O',title = 'Total salary'),
    y=alt.Y('mean(grade):Q', title='Average grade'),
).properties(
```

```
    title = 'Average grade per total salary range ',
    height=350,
    width=400
)
```

Out[28]:

Students who do higher paying jobs have lower grades.

Transport and Accomodation

In [29]:
```
# Distribution of transportation
df.transport_uni.value_counts()
```

Out[29]:
```
transport_uni
1    98
2    25
4    21
3     1
Name: count, dtype: int64
```

70% of students take bus, whereas remaining take private car/taxi or bicycle.

In [30]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('transport_uni:O',title = 'Transportation'),
    y=alt.Y('mean(grade):Q', title='Average grade'),
).properties(
    title = 'Average grade per Mode of transport',
    height=350,
    width=400
)
```

Out[30]:

Students who cycles had significantly below average grades.

In [31]:
```
# Distribution of accomodation
df.acc_type.value_counts()
```

Out[31]:
```
acc_type
1    68
2    49
3    27
4     1
Name: count, dtype: int64
```

Majority of the students lived in rental houses followed by dormitories. Remaining lived with family.

In [32]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('acc_type:O',title = 'Accomodation type'),
    y=alt.Y('mean(grade):Q', title='Average grade'),
).properties(
    title = 'Average grade per Accomodation type',
    height=350,
    width=400
)
```

Out[32]:

Accomodation type does not significantly affect grades (`Other` accomodation type has small sample size to consider).

Family

Mother's and Father's Education

In [33]:
```
# Distribution of mother's education
df.mother_edu.value_counts()
```

Out[33]:
```
mother_edu
1    54
3    39
2    27
4    21
5     2
6     2
Name: count, dtype: int64
```

Only 4 mother's have done Master's or PhD.

In [34]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('mother_edu:O',title = 'Mother\'s Education'),
    y=alt.Y('mean(grade):Q', title='Average grade'),
).properties(
    title = 'Average grade per Mother\'s Education',
    height=350,
    width=400
)
```

Out[34]:

No signifcant trend seen in student's grades with mother's education. Students with mothers having MSc and PhD have too small sample size to compare.

In [35]:
```
# Distribution of father's education
df.father_edu.value_counts()
```

Out[35]:
```
father_edu
3    46
2    36
1    29
4    28
5     5
6     1
Name: count, dtype: int64
```

Only 5 father's have done Masters and 1 father with PhD.

In [36]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('father_edu:O',title = 'Father\'s Education'),
    y=alt.Y('mean(grade):Q', title='Average grade'),
).properties(
    title = 'Average grade per Father\'s Education',
    height=350,
    width=400
)
```

Out[36]:

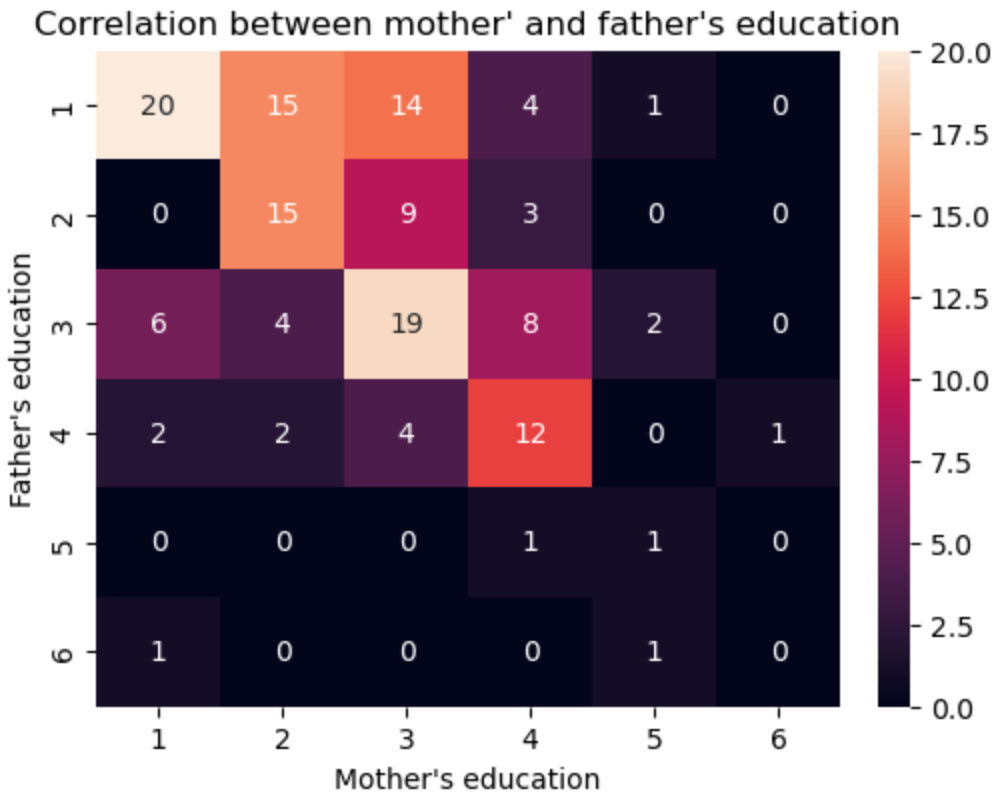
Students whose father's have higher education levels tend to have higher grades.

Correlation between education level of parents

In [37]:

```
# Pivot data
data = df.groupby(['mother_edu', 'father_edu']).size().reset_index()
data.sort_values(by=['mother_edu', 'father_edu'], inplace=True)
data = data.pivot(index='mother_edu', columns='father_edu').fillna(0)
data.columns = data.columns.droplevel(0)

# Plot mother and fathers education
plt.figure(figsize=(5, 4), constrained_layout=True)
sns.heatmap(data.astype(int), annot=True, fmt='d')
plt.xlabel('Mother\'s education')
plt.ylabel('Father\'s education')
plt.title('Correlation between mother\' and father\'s education', fontsize=12)
plt.show()
```



The parents of students tend to marry among the same education level in general. There are significant cases where father's education is higher than that of the mother but there are very few parents with the opposite behaviour.

Educational Habits

Expected CGPA and Last Semester CGPA

In [38]:

```
# Distribution of expected cgpa
df.cgpa_expected.value_counts()
```

Out[38]:

```
cgpa_expected
3    61
2    38
4    30
```

```
1    16
Name: count, dtype: int64
```

In [39]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('cgpa_expected:O',title = 'Expected CGPA'),
    y=alt.Y('mean(grade):Q', title='Average grade'),
).properties(
    title = 'Expected CGPA per Accomodation type',
    height=350,
    width=400
)
```

Out[39]:

It seems that the expectation matches the actual grades where higher the expected CGPA, higher the grades.

In [40]:
```
# Distribution of expected cgpa
df.cgpa_last_sem.value_counts()
```

Out[40]:
```
cgpa_last_sem
4    40
2    38
3    25
5    25
1    17
Name: count, dtype: int64
```

In [41]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('cgpa_last_sem:O',title = 'CGPA of last semester'),
    y=alt.Y('mean(grade):Q', title='Average grade'),
).properties(
    title = 'CGPA of last semester per Accomodation type',
    height=350,
    width=400
)
```

Out[41]:

Students who scored low in last semester had low grades, whereas those who scored higher scored high grades, although there is no straighforward linear trend.

Course ID

Due to time constraints, could not do a complete EDA

In [42]:
```
# Distribution of course id
df.course_id.value_counts()
```

Out[42]:
```
course_id
1    66
9    21
7    15
8    14
3     8
6     8
5     7
4     4
2     2
Name: count, dtype: int64
```

Half of the students study Course 1.

In [43]:
```
#Plot bar chart
alt.Chart(df).mark_bar().encode(
    x=alt.X('course_id:O',title = 'Course ID'),
    y=alt.Y('mean(grade):Q', title='Average grade'),
).properties(
    title = 'CGPA of last semester per Course',
    height=350,
    width=400
)
```

Out[43]:

Students from Course 3 and 7 had the very high grade on average whereas the students from Course 1, 8 and 9 had very poor grades.

Export data

In [44]:
```
# Export to parquet
df.to_parquet(EXPORT + r"student_data.pqt",engine='pyarrow')
```