ME- Design Area Meeting
April 18, 2022 @ 1:30 pm

https://purdue.webex.com/purdue/j.php?MTID=m2447ecff7217299398 91c8913fc6d282
Meeting number (access code): 2622 168 5420
Meeting password: Design_2022

Join by phone
+1-855-282-6330 US TOLL FREE
+1-415-655-0003 US TOLL

1. Discussion of Area Chair Term Limit
    a. 3year Area Chair Term Limit
2. In the past the Area Chair has always been a senior faculty (full professor)
    a. Continue with current approach (full professor)
    b. Change procedure and allow associate professors, etc. Please note this is up to Eckhard's approval.
    c. I have sent you an email regarding the above, only two people responded. Agenda items 1 and 2 – 30 minutes.
3. Proposal from Ilias for the course waiver option for the math area exam. Ilias shows his data analysis and provides the recommendation in the last paragraph. Please review the attached and be prepared for discussion. Agenda item 3 – 30 minutes.

1.) Possibility of replacing MA 303 with a yet to be defined Data Science/Statistical Analysis course. Please see attached the syllabus
2.) Possibility of replacing MSE 230 with a yet to be defined junior level design/manufacturing course that completes the desired ME 263 - ME 3xx - ME 463 sequence. Please see attached the syllabus.
3.) Any updates to the desired ME 263 - ME 3xx - ME 463 sequence.
4.) graduate student visitation on 2/24 to 2/26 – please see attached.

math_area_exam_waiver_options

March 25, 2022

1 Math Area Exam Waiver Options

- Author: Ilias Bilionis
- Date: 3/24/2022

The purpose of this document is to study the grade distributions of MA 527 and MA 528 and suggest a grade threshold for a math area exam waiver. The waiver could be of the form:

> The graduate student does not have to take the math area exam if the pass MA 527 with a grade greater than or equal to X and MA 528 with a grade greater than or equal to Y.

We should choose X and Y that the student that meets the waiver criterion has very high probability of passing the math area exam.

Unfortunately, I do not have all the data we need to do a thorough analysis of this question. So, my recommendation is an educated guess.

In what follows I use the data for MA 527 and MA 528 for the past four years.

[8]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
```

[2]:
```
df = pd.read_excel("grade-dist-ma527-ma528-201820-202210.xlsx",␣
↪sheet_name="Cleaned")
```

Get the raw data:

[3]:
```
df
```

[3]:

	CRN	Course	A+	A	A-	B+	B	B-	C+	C	…	D-	F	AU	\
0	202210	MA52700	21	54	21	9	72	8.0	NaN	2.0	…	NaN	NaN	NaN	
1	202120	MA52800	24	25	8	12	36	7.0	3.0	1.0	…	NaN	NaN	NaN	
2	202110	MA52700	3	55	13	9	82	6.0	2.0	2.0	…	NaN	1.0	NaN	
3	202020	MA52800	16	50	11	19	6	3.0	NaN	NaN	…	NaN	NaN	2.0	
4	202010	MA52700	4	57	22	26	70	21.0	5.0	6.0	…	NaN	4.0	2.0	
5	201920	MA52800	6	17	17	15	32	NaN	NaN	2.0	…	NaN	1.0	NaN	
6	201910	MA52700	14	81	30	22	45	32.0	6.0	4.0	…	NaN	2.0	2.0	

```
7  201820  MA52800  20  24   4  13  28  31.0  NaN  3.0  … NaN  3.0  NaN

     I   N    P   S    W   WF   E
0  NaN NaN  NaN NaN  7.0  NaN NaN
1  NaN NaN  NaN NaN  6.0  NaN NaN
2  1.0 NaN  1.0 NaN  7.0  NaN NaN
3  NaN NaN  NaN NaN  2.0  NaN NaN
4  NaN NaN  NaN NaN  NaN  3.0 NaN
5  NaN NaN  NaN NaN  3.0  NaN NaN
6  NaN NaN  NaN NaN  1.0  NaN NaN
7  NaN NaN  NaN NaN  3.0  NaN NaN

[8 rows x 23 columns]
```

Remove the NaN:

[4]:
```
df = df.fillna(0)
df
```

[4]:
```
      CRN   Course  A+   A  A-  B+   B    B-   C+    C  …   D-    F   AU  \
0  202210  MA52700  21  54  21   9  72   8.0  0.0  2.0  …  0.0  0.0  0.0
1  202120  MA52800  24  25   8  12  36   7.0  3.0  1.0  …  0.0  0.0  0.0
2  202110  MA52700   3  55  13   9  82   6.0  2.0  2.0  …  0.0  1.0  0.0
3  202020  MA52800  16  50  11  19   6   3.0  0.0  0.0  …  0.0  0.0  2.0
4  202010  MA52700   4  57  22  26  70  21.0  5.0  6.0  …  0.0  4.0  2.0
5  201920  MA52800   6  17  17  15  32   0.0  0.0  2.0  …  0.0  1.0  0.0
6  201910  MA52700  14  81  30  22  45  32.0  6.0  4.0  …  0.0  2.0  2.0
7  201820  MA52800  20  24   4  13  28  31.0  0.0  3.0  …  0.0  3.0  0.0

     I    N    P    S    W   WF    E
0  0.0  0.0  0.0  0.0  7.0  0.0  0.0
1  0.0  0.0  0.0  0.0  6.0  0.0  0.0
2  1.0  0.0  1.0  0.0  7.0  0.0  0.0
3  0.0  0.0  0.0  0.0  2.0  0.0  0.0
4  0.0  0.0  0.0  0.0  0.0  3.0  0.0
5  0.0  0.0  0.0  0.0  3.0  0.0  0.0
6  0.0  0.0  0.0  0.0  1.0  0.0  0.0
7  0.0  0.0  0.0  0.0  3.0  0.0  0.0

[8 rows x 23 columns]
```

Let's gather sum all the students for each grade accross all courses.

[5]:
```
courses = df["Course"].unique()
grades = df.columns[2:]
summed_grades = {}
for c in courses:
    idx = df["Course"] == c
```

```
    row = {"Course": c}
    summed_grades.update(
        {c: dict(df[idx][grades].sum())}
    )
```

Here are the processed data:

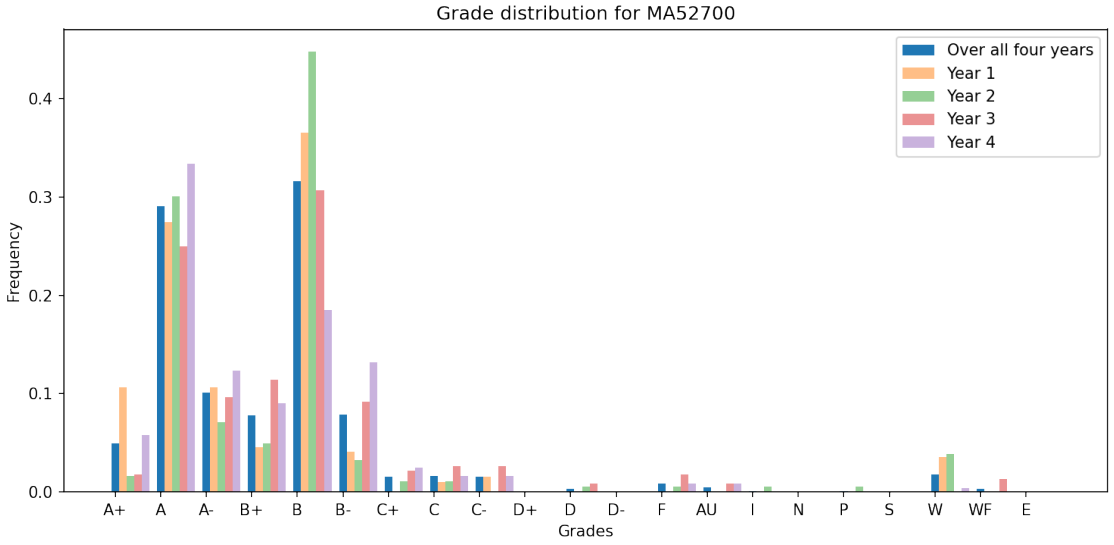
[6]:
```
summed_grades
```

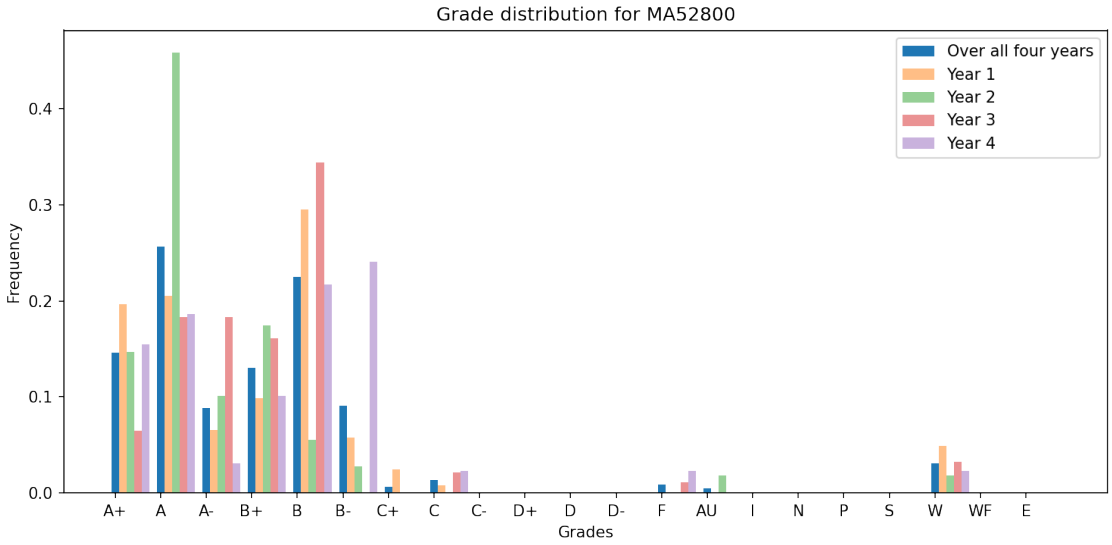
[6]:
```
{'MA52700': {'A+': 42.0,
  'A': 247.0,
  'A-': 86.0,
  'B+': 66.0,
  'B': 269.0,
  'B-': 67.0,
  'C+': 13.0,
  'C': 14.0,
  'C-': 13.0,
  'D+': 0.0,
  'D': 3.0,
  'D-': 0.0,
  'F': 7.0,
  'AU': 4.0,
  'I': 1.0,
  'N': 0.0,
  'P': 1.0,
  'S': 0.0,
  'W': 15.0,
  'WF': 3.0,
  'E': 0.0},
 'MA52800': {'A+': 66.0,
  'A': 116.0,
  'A-': 40.0,
  'B+': 59.0,
  'B': 102.0,
  'B-': 41.0,
  'C+': 3.0,
  'C': 6.0,
  'C-': 0.0,
  'D+': 0.0,
  'D': 0.0,
  'D-': 0.0,
  'F': 4.0,
  'AU': 2.0,
  'I': 0.0,
  'N': 0.0,
  'P': 0.0,
  'S': 0.0,
```

```
 'W': 14.0,
 'WF': 0.0,
 'E': 0.0}}
```

Let's now do the histograms for these:

[7]:
```
for c, c_grades in summed_grades.items():
    fig, ax = plt.subplots(dpi=150, figsize=(10, 5))
    ax.set_title(f"Grade distribution for {c}")
    x = 3.0 * np.arange(len(c_grades))
    y = np.array([yy for yy in c_grades.values()])
    y /= np.sum(y)
    ax.bar(x, y, width=0.5, label="Over all four years")
    idx = df["Course"] == c
    for i, row in enumerate(df[idx].iterrows()):
        y = np.array([yy for yy in dict(row[1][2:]).values()])
        y /= np.sum(y)
        ax.bar(x + (i + 1) * 0.5, y, width=0.5, label=f"Year {i + 1}", alpha=0.
↪5)
    ax.set_xticks(x)
    ax.set_xticklabels(c_grades.keys())
    ax.set_xlabel("Grades")
    ax.set_ylabel("Frequency")
    plt.legend(loc='best')
    plt.tight_layout()
```





The interesting observation is that for that grade distribution for all problem and all years seem to be bimodal. One mode is always at A. The other mode is mostly at B, but some times it is at B+, e.g., see Year 2 of MA 528).

Now, some input from my experience a math area exam chair for the past three years. I have never seen a student with grades higher than $A-$ in both courses fail the exam. But, I have seen students with A in one of these courses fail the exam. And I have seen students with B's in these courses fail the exam.

My recommendation for the waiver is that the minimum grade threshold should be $X, Y = A-$ (Option 1). or $X, Y = A$ (Option 2). I think $X, Y = B+$ or lower is a bad choice (Option 3).

Please take this recommendation with a grain of salt because it is only based on the above data and on my personal experience.

[ ]: