

ENGR 1020 Freshman Engineering Seminar Final Assessment

Name

Date

Directions

SHOW YOUR COMPLETE WORK (steps, calculations, assumptions, etc.) if you would like to RECEIVE ANY CREDIT

NOTE 1: This is an Individual Assessment and NOT a Group Assessment. If any solutions are the same, then each of those students will receive a grade of a “0” on the Final Assessment and those students will repeat the course again next semester.

NOTE 2: For each problem, you can either solve the problem using R or MATLAB(R)/GNU Octave (no Microsoft Excel) and/or you can solve the problem by hand on engineering paper and/or here (feel free to use the backside). If using R or MATLAB(R)/GNU Octave, then include your complete source code (input) along with your answers (output).

Be sure to include units and use significant figures appropriately

Write neatly in pencil — work in pen will NOT be accepted

You will have until 4:55 PM on Monday, 30 November 2015 and no LATER to turn the Final Assessment in to me in Holland Hall 106, thus the Assessment can not be e-mailed to me.

Cite your references as needed (use the citations at the end of this Assessment and/or the Mid-Term Report for reference)

Read the directions carefully
6 points 1) Name 6 TSU College of Engineering undergraduate degree programs.

1 point 2) TRUE or FALSE
The following groups are bound by the engineering code of ethics: graduates of engineering programs, Professional Engineers, land surveyors, and nongraduates of engineering programs.

1 point 3) TRUE or FALSE
The engineering practice of ethical obligations is to protect the environment (Earth’s ecosystems and the basis for human societies), human beings, and the prosperity of human beings from both injury and harm.

1 point $4) TRUE or FALSE
Tradeoffs revolving around competing issues of risk vs. benefit, or safety vs. economics may require judgments that are fully addressed simply by application of the code [of ethics].

1 point 5) What is the name of the exam that you can take as a senior undergraduate student, in an accredited engineering program, that leads to the possibility of professional engineering registration?

1 point 6) After you take and pass the exam in Problem 5) you are given a registration certificate, what is the name of the certification?

1 point 7) In order to sit for the Principles and Practice of Engineering Examination, what 2 things must you have already completed?

7 points 8) Name 7 of the sections required by the TSU College of Engineering Problem Solving format?

2 points 9) If a person driving a car is traveling at 1345.19 Mm/day, what is their speed in miles/sec?

2 points 10) If \( \text{variable1} = 0.36875 \) , what is the value of \( \text{answer1} \), where \( \text{answer1} = 12439.6\text{variable1}^9 + 162.85\text{variable1}^4 - 20.3285\text{variable1}^2 + 733.2024\text{variable1} - 0.60458713 \) ?

[4 points total] 11)
1 point 11) a) In R, the following is typed on the command line:

\[
> \text{single} \leftarrow 10.4321:45.0000000000000045
\]

What is the output?

1 point 11) b) In R, the following is typed on the command line:
What is the output?

1 point 11) c) In R, the following is typed on the command line:

```r
> singles <- seq(10.4321, 45.0000000000000045, by = 12)
```

What is the output?

1 point 11) d) In R, the following is typed on the command line:

```r
> Singles
```

What is the output?

[11 points total] 12) Find Team Norms and Communication: Senior Design 2006 Resources: Mechanical Engineering at the University of Delaware on the class Web page: http://www.ecoccs.com/tsuteach.html. Read the first 5 pages of the document in order to answer the following questions:

1 point 12) a) **TRUE** or **FALSE**
Reacting to the person speaking is an effective listening behavior.

1 point 12) b) **TRUE** or **FALSE**
Verbal communication is the most important part of face-to-face or in-person communication.

1 point 12) c) **TRUE** or **FALSE**
Future engineering employers care about their potential employee’s ability to effectively communicate.

1 point 12) d) **TRUE** or **FALSE**
The intention of the listener/reader and the intention of the speaker/author do not matter in engineering communications.

4 points 12) e) Name all of the types of communication found in the Lecture Notes.

1 point 12) f) **TRUE** or **FALSE**
It is a good idea to have numbers, special characters, and/or use personal nicknames in a professional electronic mail (e-mail) address.

1 point 12) g) **TRUE** or **FALSE**
It is a good idea to not solely have a combination of your first and last name in a professional electronic mail (e-mail) address.

1 point 12) h) **TRUE** or **FALSE**

It is a good idea to include the course number and your name in the subject of an electronic mail (e-mail) message to one of your professors.

3 points 13) Based on the following figure, what information is missing, if anything, based on the Lecture 5a Notes?

![Figure](image.png)

[4 points total] *14) “... In all of these cases, the agenda to recycle has superseded other design considerations. Just because a material is recycled does not automatically make it ecologically benign, especially if it was not designed specifically for recycling. Blindly adopting superficial environmental approaches without fully understanding their effects can be no better—and perhaps even worse—than doing nothing. ...

2 points 14) a) With regards to engineering ethics, should engineers care about the whole life cycle of the products that we design? Why or why not? (Answer in complete sentences)

2 points 14) b) Do you agree with the above excerpt from *Cradle to Cradle: Remaking the Way We Make Things* by William McDonough & Michael Braungart? Why or why not? (Answer in complete sentences)

[17 points total] ^!*15) Based on the following data set,

9 points 15) a) what are the values of the measures of central tendency for Beryllium-7?

8 points 15) b) what are the measures of dispersion for Beryllium-7?

http://www.ecoccs.com/radddata_Nashville.csv is the link to the data in csv format
http://www.ecoccs.com/radddata_Nash.RData is the link to the data in RData format (only viewable through R or RStudio and is best viewed using library(data.table)

[17 points total] @!16) Based on the following data set,

9 points 16) a) what are the values of the measures of central tendency for Lead-212?

8 points 16) b) what are the measures of dispersion for Lead-212?
http://www.ecoccs.com/fukushima_leads.csv is the link to the data in csv format
http://www.ecoccs.com/fukushima_leads.RData is the link to the data in RData format (only viewable through R or RStudio and is best viewed using library(data.table))

[17 points total] @!17) Based on the following data set,

9 points 17) a) what are the values of the measures of central tendency for Thallium-208?

8 points 17) b) what are the measures of dispersion for Thallium-208?

http://www.ecoccs.com/fukushima_thalliums.csv is the link to the data in csv format
http://www.ecoccs.com/fukushima_thalliums.RData is the link to the data in RData format (only viewable through R or RStudio and is best viewed using library(data.table))

[10 points total] #18) It is known that the tensile strength of a plastic increases as a function of time it is heat treated. The following data is collected:

<table>
<thead>
<tr>
<th>Time</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>40</th>
<th>50</th>
<th>55</th>
<th>60</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>5</td>
<td>20</td>
<td>18</td>
<td>40</td>
<td>33</td>
<td>54</td>
<td>70</td>
<td>60</td>
<td>78</td>
</tr>
</tbody>
</table>

5 points 18) a) Fit a straight line to this data and use the equation to determine the tensile strength at a time of 63.5 min.

3 points 18) b) Use linear interpolation to find the tensile strength at a time of 63.5 minutes.

2 points 18) c) Assuming that the answer in a) is the true value, then what is the relative error?

[6 points total] ^19) Regarding the Error Analysis of Launch Data (from Lecture 6 Notes),

2 points 19) a) why is the average error calculation misleading?

2 points 19) b) why is the square root of the average of the square of the error a better indicator of the accuracy of the launcher than the average error?

2 points 19) c) how does the standard deviation value compare with the results from Part (c) [from Lecture 6 Notes]?

[10 points total] ^20)

4 points ^20) a) Fill in the table with the missing information:

Counts or frequencies of launch distances sorted into bins.
<table>
<thead>
<tr>
<th>bid ID, ( i )</th>
<th>range</th>
<th>count, ( N(i) )</th>
<th>probability, ( P(i) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>( 14 \leq d &lt; 15 )</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>( 15 \leq d &lt; 16 )</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>( 16 \leq d &lt; 17 )</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>( 17 \leq d &lt; 18 )</td>
<td></td>
<td>0.35</td>
</tr>
<tr>
<td>18</td>
<td>( 18 \leq d &lt; 19 )</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>( 19 \leq d &lt; 20 )</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>( 14 \leq d &lt; 20 )</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

3 points \( ^{20} \) b) Use a histogram to plot the count per distance.

3 points \( ^{20} \) c) Use a histogram to plot the probability per distance.

2 points \( ^{21} \) The supervisor of a group of 20 construction workers wants to get the opinion of 2 of them (to be selected at random) about certain new safety regulations. If 12 of them favor the new regulations and the other 8 are against it, what is the probability that both of the workers chosen by the supervisor will be against the new safety regulations?

2 points \( ^{22} \) Suppose that we wish to create a team of 17 people out of a class of 21 people, how many different teams are possible?

2 points \( ^{23} \) Suppose that we wish to create a team of 17 people out of a class of 23 people so that each team is unique with regards to the order chosen, how many distinct teams are possible?

[6 points total] \( ^{24} \) Suppose that LRB Engineers, Inc. tested the depleted uranium (DU) shell on its weapons system over the course of 27,160 hours and there were 8,524 failures during that time period.

2 points \( ^{24} \) a) What is the failure rate?

2 points \( ^{24} \) b) If the maximum failure rate for this system is 0.293 failures per hour, then is this failure rate acceptable? (Answer in complete sentences)

2 points \( ^{24} \) c) If Cruft Lipshod, the company CEO, asks you to change the test data if it’s above the maximum failure rate, then what is your ethical response, as the engineer on this project? (Answer in complete sentences)

3 points \( ^{25} \) A person borrows A$13,247.75 (Australian dollars) at an annual interest rate of 26.13% with the entire amount due in 12 years. How much must be paid at the end of the period in US dollars?

3 points \( ^{26} \) Refer to Problem 25) above, how much must be paid, in US dollars, at the end of the period if interest is compounded monthly?
3 points 27) A small municipality experiences inflation of 20% per month. What is the effective annual inflation rate?

2 points 28) If the LRB Engineers Credit Union pays 0.9915% interest compounded quarterly, then what is the effective annual interest rate?

16 points 29) Consider the value of $1 that you might receive in 1, 10, 50, and 100 years. The relevant compound interest formula (model) given in most economics/investment texts is

\[ P = \frac{S_n}{(1 + i)^n} \]

This gives the present worth (PW) equivalent (P) of an amount \( S_n \) occurring at year \( n \), at interest/discount rate \( i \). \( 1/(1 + i)^n \) is termed the present worth factor.

Do this calculation for interest/discount rates, \( i \), of 1%, 5%, 10%, and 25% per annum (year), and years, \( n \), of 1, 10, 50, and 100. Use the following table:

<table>
<thead>
<tr>
<th></th>
<th>1 Year</th>
<th>10 Years</th>
<th>50 Years</th>
<th>100 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9 points 30) LRB Engineers, Inc. is interested in purchasing either a new or used dump truck at 24.139% annual interest rate. Use the information in the table below to help LRB Engineers, Inc. decide which dump truck to purchase using the benefit-cost ratio discussed in Lecture 7 Notes. Which dump truck should the company purchase and why? (Answer in complete sentences)

<table>
<thead>
<tr>
<th></th>
<th>Used dump truck</th>
<th>New dump truck</th>
</tr>
</thead>
<tbody>
<tr>
<td>initial cost</td>
<td>£100,000</td>
<td>£250,000</td>
</tr>
<tr>
<td>life</td>
<td>18 years</td>
<td>22 years</td>
</tr>
<tr>
<td>annual operations and maintenance (O &amp; M)</td>
<td>£3,000</td>
<td>£45,000</td>
</tr>
<tr>
<td>annual benefits</td>
<td>£250,000</td>
<td>£220,000</td>
</tr>
<tr>
<td>salvage value</td>
<td>£25,000</td>
<td>£70,000</td>
</tr>
</tbody>
</table>

5 points 31) Name at minimum 5 of Irucka Embry’s Grand Challenges to Engineering [http://www.ecoccs.com/grand_challenges_engineering.html]. (Answer in complete sentences)
Extra Credit

For each extra credit problem, you can either solve the problem using R or MATLAB(R)/GNU Octave (no Microsoft Excel)

10 points extra credit #1) An amount of money P is invested in an account where interest is compounded at the end of the period. The future worth F yielded at an interest rate i after n periods may be determined from the following formula:

\[ F = P \times (1 + i)^n \]

Write a function that will calculate the future worth of an investment for each year from 1 through n. The input to the function should include the initial investment P, the interest rate i (as a decimal), and the number of years n for which the future worth is to be calculated. The output should consist of a table with headings and columns for n and F. Run the program for P = £285,940.45 (British pound), i = 7.1284%, and n = 17 years. Provide the table in US dollars.

10 points extra credit #2) Economic formulas are available to compute annual payments for loans. Suppose that you borrow an amount of money P and agree to repay it in n annual payments at an interest rate of i. The formula to compute the annual payment A is

\[ A = P \times \frac{i(1 + i)^n}{(1 + i)^n - 1} \]

Write a function to compute A. Test it with P = C$759,214.68 (Canadian dollars) and an interest rate of 6.216%. Compute results for n = 1:20 and display the results as a table with headings and columns for n and A. Provide the table in US dollars.

*! The following currency conversions apply to Problems 3 - 6: $1 = 5.045 francs (Fr)
1 yen (Y) = $0.0101239
1.4682 deutsche mark (DM) = $1

5 points extra credit *!3) Generate a table of conversions from francs to dollars. Start the francs column at 1 Fr and increment by 1 Fr. Print 100 lines in the table.

5 points extra credit *!4) Generate a table of conversions from deutsche marks to francs. Start the deutsche marks column at 1 DM and increment by 1 DM. Print 100 lines in the table.

5 points extra credit *!5) Generate a table of conversions from yen to deutsche marks. Start the yen column at 1 Y, and print 100 lines.
5 points extra credit *!6) Generate a table of conversions from dollars to francs, deutsche marks, and yen. Start the column with $1, and increment by $1. Print 100 lines in the table.

Works Cited


