MATH 1108 Final Exam
Fall 2021

- No books or notes are permitted.
- No electronic devices are permitted.
- Make sure to show all work. Answer the questions in your exam book. If possible, write one answer per page, go in order, and leave a page blank if you skip that question.
- You are not required to simplify your answers. You may leave expressions such as ${}_nC_k$, ${}_nP_k$, $n!$, powers, etc. as they are.
- Write a calculator-ready expression for your final answer.
- Three mathematical finance formulas are provided below. The table from Appendix C in your textbook is also attached.
- You have two hours to complete this exam. Good luck!

$$A = P(1+i)^n$$
$$\text{FV}_{\text{ann}} = \text{PMT}\frac{((1+i)^n - 1)}{i}$$
$$\text{PV}_{\text{ann}} = \text{PMT}\frac{(1-(1+i)^{-n})}{i}$$

1. (10 points) Translate the following word problem into a mathematical linear programming problem. Do not solve it.

   The Old-World Class Ring Company designs and sells two types of rings: brass and gold. They can produce up to 24 rings each day using up to 60 total person-hours of labor. It takes 3 person-hours to make one brass ring and 2 person-hours to make one gold ring. The profit on a brass ring is \$40 and on a gold ring is \$30. The company wants to know how many of each type of ring should be made daily to maximize their profit.

   Write a mathematical linear programming problem whose solution would tell the company how to accomplish their goal. You do not need to solve the problem you write.

2. (10 points) For the following objective function and feasible region, determine whether the maximum and/or minimum exist, and find them if they exist.

   Objective function: $z = 4x + 5y$
   Feasible region: $x - y \leq 5$
   $2x + y \geq 15$
   $x \geq 0$
   $y \geq 0$

3. (5 points) How long will it take \$20,000 to grow to \$31,000 if it is invested at 5% compounded quarterly?

4. (5 points) Ian deposits \$100 in a savings account at the end of each month for 7 years, where the interest rate is 3% compounded monthly. How much interest does he earn over this period?

Exam continues on next page

5. (10 points) Jack and Jill take out a 25-year loan for $400,000 to buy a house. The annual rate is 4.6% compounded semiannually. Let PMT represent their semiannual payment.
   (a) Write a calculator-ready expression for PMT.
   (b) If they sell their house after 10 years, what is the unpaid balance of the loan? You may write your answer in terms of the variable PMT.

6. (5 points) A 10-person team is interviewing candidates for an internship. The team includes 4 directors and 6 analysts. The interview committee will be composed of 2 directors and 2 analysts. How many different committees are possible?

7. (5 points) 10 teams of students need to present their final projects in a class. The presentations will take place over two class periods, with five presentations each period. How many different schedules are possible for the first period of presentations?

8. (5 points) Find the probability of getting a hand of 2 Kings, 2 Queens, and 1 Jack (not necessarily in that order) when you draw 5 cards from a standard 52-card deck without replacement.

9. (5 points) A watchmaker offers its customers a 10-year warranty on new watches. Their data indicates that in this time, 5% of customers will require a full replacement, an additional 15% of customers will require one battery replacement, and a further 5% of customers will require two battery replacements. A full replacement costs $200, and each battery replacement costs $15. What is the expected cost per watch of this warranty program?

10. (10 points) Two stores sell a certain model of MP3 player. Store A has 34% of the sales, 5% of which are of defective items, and Store B has 66% of the sales, 1% of which are of defective items. The difference in defective rates is due to different levels of pre-sale checking of the product. A person receives a defective item of this product as a gift. What is the probability it came from Store B?

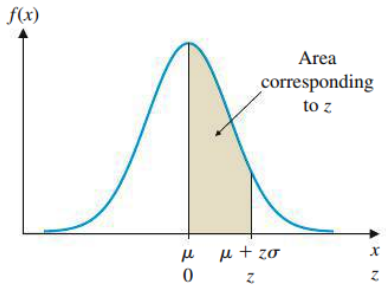
11. (10 points) A botanist wants to grow a rare plant in his greenhouse. The probability that a given bulb will mature is 0.42. Suppose 6 bulbs are planted. Assuming the bulbs are independent of one another, what is the probability that
   (a) Exactly 4 bulbs will mature
   (b) 3 or more bulbs will mature

12. (10 points) The mean clotting time of blood is 8 seconds, with a standard deviation of 2 seconds. Suppose that the clotting time of blood is approximated by a normal curve. What is the probability that blood clotting time will be
   (a) Less than 5 seconds
   (b) At least 10.5 seconds

13. (10 points) 2% of flat irons produced at a certain plant are defective. Estimate the probability that of 10,000 randomly selected flat irons, the number of defective irons is between 197 and 210 inclusive.

Appendix

C Area under the Standard Normal Curve



Area under the Standard Normal Curve

(Table Entries Represent the Area under the Standard Normal Curve from 0 to z, $z \geq 0$)

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998
3.6	0.4998	0.4998	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.7	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.8	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000