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Detail procedures and calculations must be provided to support final answers otherwise no points will be granted.

1. (4 points) Suppose $f(X,Y)=\frac{X+2Y}{18}$, X=1, 2; Y=1, 2. Please find Cov(X, Y).

2. (3 points) The following table contains ages of sophomore students in a university. Please find the mean and variance.

Age	19	20	21	22	23
Probability	10%	27.5%	30%	17.5%	15%

3. (3 points) When randomly select samples of 200 men between age 40 and 55, a survey finds 5% of selected men have heart attach within 5 years. Assign H as following; please find the binomial distribution of H and its mean and standard deviation.
H: {the number of people who would not get heart attach},

4. (8 points) Draw one card at random from a standard deck of cards. The sample space S is the collection of the 52 cards. Assume that the probability set function assigns 1/52 to each of these 52 outcomes. Treat ace as number 1 in this question. Let
A = {x is smaller or equal to 5 and x is club},
B = {x is a 5, 6 or 7 and x is black},
C = {x is heart 7}.
Find (a) P(A and B), (b) P(B or C), (c) P(B | A) and (d) P(A | C).

5. (6 points) The first-round baseball postseason series of major league baseball (MLB) continues until one of two teams wins three games; therefore, the series can go either three games, four games or five games. (a) How many different orders are possible for a series? (b) What is the probability the series goes four games?

6. (4 points) Suppose the probability density of X is $f(x) = \beta x^2(1-x)^3$ for $0 < x < 1$. Find the probability $P(0.3 < X < 0.8)$.

7. (4 points) A teacher likes to know whether men's heights of senior high school students are taller than all high school students. He takes a sample of six senior male students and records their heights as below, and he also knows the average height of all male high school students is 67. Conduct test of significance with proper statements of hypotheses at 95% confidence level.
69 68 71 68 63 72

8. (4 points) A labor economist likes to know how the wage rate affect hours worked for people. He has following 5 people's data as below. Find the correlation between the two variables. How does the correlation indicate level of relationship?

Wage per hour ($)	17	15	11	18	10
Hours worked per week	31	34	31	39	30

9. (6 points) A survey studies the relationship between exercises and health. Table below shows number of responses of the survey for each category. X and H are the self-reported levels of exercises and health conditions. Where $X = 1$ means no exercise, $X = 2$ means some exercises, and $X = 3$ means regular exercise. $H = 0$ means worse than average health condition, and $H = 1$ means better than average health condition.

$X \backslash H$	0	1
1	20	10
2	5	25
3	15	25

(a) Find $P(X = 2 \mid H = 0)$

(b) Find $P[(H = 1)$ and $(X = 2$ or $3)]$

10. (4 points) A campus program evenly enrolls undergraduate and graduate students. If a random sample of 5 students is selected from the program to be interviewed about the introduction of a new fast food outlet on the ground floor of the campus building, what is the probability that all 5 students selected are undergraduate students?

11. (3 points) If $n = 10$ and $p = 0.60$, then the standard deviation of the binomial distribution is?

12. (4 points) For some positive value of X, the probability that a standard normal variable is between 0 and $+2X$ is 0.2019. The value of X is

13. (4 points) If we know that the length of time it takes a college student to find a parking spot in the library parking lot follows a normal distribution with a mean of 3.5 minutes and a standard deviation of 1 minute, find the probability that a randomly selected college student will take between 2.5 and 5 minutes to find a parking spot in the library parking lot.

14. (4 points) The owner of a fish market has an assistant who has determined that the weights of catfish are normally distributed, with mean of 3.2 pounds and standard deviation of 0.8 pound. If a sample of 16 fishes yields a mean of 3.6 pounds, what is the Z-score for this observation?

15. (4 points) When testing H_0: $\mu_1 - \mu_2 = 0$ verse H_1: $\mu_1 - \mu_2 \neq 0$, the observed value of the Z-score was found to be -2.15. The p-value for this test would be?

16. (6 points) From a GMAT exam, $GM \sim N(480, 50)$. (a) Find the probabilities that for a random selection of score, it's lower than 350. (b) 80% of exam takers would have their results above what score?

17. (4 points) To determine the average age of its customers, a large manufacturer of men's clothing took a random sample of 50 customers and found $\bar{x} = 36$. Assuming $\sigma = 12$; please find the 95% confidence interval for the mean age μ of all the customers.

18. (4 points) A social policy researcher likes to study the duration of unemployment – average in days of being unemployed. From his old studies, he knows the standard deviation for days of unemployed is 25 days. If he wants his estimated mean being ± 5 days at 95% confidence level, how many unemployed people he needs to randomly select in his sample?

19. (6 points) A cloth designer wants to know whether the average size of waist of men increases for the past 10 years. She knows the average size was 33.5 inches with standard deviation 5.5 inches 10 year ago. The designer also assumes an increase of the waist size of men because of worse diet behavior than a decade ago. From a sample of 20, she finds that the mean waist size is 35.2 inches.
    (a) What should be her null hypothesis and alternative hypothesis?
    (b) What is the p-value?
    (c) Should she accept her null at 95% statistically significant level? At 90%?

20. (15 points) A study tries to find out the relationship between education and income level. A sample is randomly selected and reported in following table:

Education X (years after Jr. High)	2	4	5	7	7
Income Y (thousands)	17	27	31	35	40

    (a) Estimate the regression line: $Y = \alpha + \beta X + e$, where e is the error term.
    (b) Is estimated β statistically significant at 5% level?
    (c) Find the R^2.
    (d) How would you conclude the research based on the regression outcome?
    (e) If the study is focusing on the effect from education in years to the rate of change in income, how should we change the model? How do you determine if this new model performs better than the original one?

<<End of exam>>

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Standard Normal Distribution (Z Table)

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

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***t* Table** (two-tailed)

d.f.	0.5	0.2	0.1	0.05	0.02	0.01	0.002
1	1.000	3.078	6.314	12.706	31.821	63.657	318.309
2	0.816	1.886	2.920	4.303	6.965	9.925	22.327
3	0.765	1.638	2.353	3.182	4.541	5.841	10.215
4	0.741	1.533	2.132	2.776	3.747	4.604	7.173
5	0.727	1.476	2.015	2.571	3.365	4.032	5.893
6	0.718	1.440	1.943	2.447	3.143	3.707	5.208
7	0.711	1.415	1.895	2.365	2.998	3.499	4.785
8	0.706	1.397	1.860	2.306	2.896	3.355	4.501
9	0.703	1.383	1.833	2.262	2.821	3.250	4.297
10	0.700	1.372	1.812	2.228	2.764	3.169	4.144
11	0.697	1.363	1.796	2.201	2.718	3.106	4.025
12	0.695	1.356	1.782	2.179	2.681	3.055	3.930
13	0.694	1.350	1.771	2.160	2.650	3.012	3.852
14	0.692	1.345	1.761	2.145	2.624	2.977	3.787
15	0.691	1.341	1.753	2.131	2.602	2.947	3.733
16	0.690	1.337	1.746	2.120	2.583	2.921	3.686
17	0.689	1.333	1.740	2.110	2.567	2.898	3.646
18	0.688	1.330	1.734	2.101	2.552	2.878	3.610
19	0.688	1.328	1.729	2.093	2.539	2.861	3.579
20	0.687	1.325	1.725	2.086	2.528	2.845	3.552
22	0.686	1.321	1.717	2.074	2.508	2.819	3.505
24	0.685	1.318	1.711	2.064	2.492	2.797	3.467
26	0.684	1.315	1.706	2.056	2.479	2.779	3.435
28	0.683	1.313	1.701	2.048	2.467	2.763	3.408
30	0.683	1.310	1.697	2.042	2.457	2.750	3.385
40	0.681	1.303	1.684	2.021	2.423	2.704	3.307
50	0.679	1.299	1.676	2.009	2.403	2.678	3.261
60	0.679	1.296	1.671	2.000	2.390	2.660	3.232
80	0.678	1.292	1.664	1.990	2.374	2.639	3.195
100	0.677	1.290	1.660	1.984	2.364	2.626	3.174
120	0.677	1.289	1.658	1.980	2.358	2.617	3.160
500	0.675	1.283	1.648	1.965	2.334	2.586	3.107
∞	0.674	1.282	1.645	1.960	2.326	2.576	3.090