Sit where you are asked to.
Wait for the signal to begin.
The exam lasts 45 min.
Remain seated until given permission to move about. No exceptions.
No extra papers, no calculators, cell phones put away.
You must neither take the exam apart nor write on anything else.
Stop writing at once when the signal is given and pass exam ahead.
Keep your eyes on your own work. No talking.
Avoid the appearance of flagrantly leaving your paper open to view.
Point penalties will be exacted for answers given without substantiation.
Point penalties will be exacted for writing after the signal to stop.
Any person arriving more than 5 min late will not take the exam.
Any person leaving without permission will be failed for the course.
Any person present in a section exam but not enrolled there will be failed.
Leave fractions unevaluated and do not reduce them.
Points will be withdrawn for sloppy work.
Show work in spaces provided. Record your answers in boxes provided.
\[
P(OIL) = 0.3, \quad P(+) \mid OIL = 0.7, \quad P(+) \mid OIL^c = 0.2.
\]

1. Determine \( P(-) \).

\[
P(OIL -) + P(noOIL -) = P(OIL) P(- \mid OIL) + P(noOIL) P(- \mid noOIL)
\]

\[
= 0.3 \cdot 0.3 + 0.7 \cdot 0.8 \quad \text{(e.g. } P(- \mid noOIL) = 1 - 0.2)\n\]

2. Determine \( P(OIL \mid -) \).

\[
P(OIL -) \div P(-) = 0.3 \cdot 0.3 \div (0.3 \cdot 0.3 + 0.7 \cdot 0.8)\n\]

\[
P(OIL) = 0.5, \quad P(OIL +) = 0.20.
\]

3. Determine \( P(OIL-) \).

\[
P(OIL) = P(OIL+) + P(OIL-)
\]

\[
0.5 = 0.2 + P(OIL-)
\]

so \( P(OIL-) = 0.3 \)

4. Determine \( P(- \mid OIL) \).

\[
P(OIL-) \div P(OIL) = 0.3 \div 0.5
\]

\[
\text{Balls will be selected without replacement from } \{B B B Y Y\}
\]

5. Determine \( P(B2) \) using total probability (show all steps taking into account draw 1).

\[
P(B1 B2) + P(Y1 B2)
\]

\[
= 3/5 \cdot 2/4 + 2/5 \cdot 3/4
\]

6. Determine \( P(Y1 B2 B3) \).

\[
P(Y1) P(B2 \mid Y1) P(B3 \mid Y1 B2)
\]

\[
= 2/5 \cdot 3/4 \cdot 2/3
\]

\[
P(rain \text{ Sat}) = 0.7, \quad P(rain \text{ Sun}) = 0.9, \quad \text{these two events are independent}
\]

7. Determine \( P(rain \text{ Sat AND rain Sun}) \).

\[
P(\text{Sat}) P(\text{Sun} \mid \text{Sat}) = P(\text{Sat}) P(\text{Sun}) \quad \text{(by independence)}
\]

\[
= 0.7 \cdot 0.9
\]

8. Determine \( P(rain \text{ Sat OR rain Sun}) \).

\[
P(\text{Sat}) + P(\text{Sun}) - P(\text{Sat Sun})
\]

\[
= 0.7 + 0.9 - 0.7 \cdot 0.9
\]
Account imbalance $X$ is normally distributed with expectation 100 and sd 2.

9. Determine the standard score of $x = 102.22$ (by hand).
   \[
   (102.22 - 100) / 2 = 2.22 / 2 = 1.11
   \]

10. Determine $P(100 < X < 102.22)$ using the Z method (no continuity correction).
    \[
    z \quad 0.01
    \]
    \[
    1.1 \quad 0.3665
    \]

\(r.v. X \text{ with } p(0) = 0.25, \ p(2) = 0.5, \ p(4) = 0.25\).

11. Determine $E \ X^2$
    \[
    E \ X^2 = \sum x^2 \ p(x) = 0^2 0.25 + 2^2 0.5 + 4^2 0.25 = 6
    \]

12. Determine $\text{Var} \ X$.
    \[
    E \ X = \sum x \ p(x) = 0 \ 0.25 + 2 \ 0.5 + 4 \ 0.25 = 2
    \]
    \[
    \text{Var} \ X = E \ X^2 - (E \ X)^2 = 6 - 4 = 2
    \]

\(r.v. X_1, \ldots, X_{100} \) are independent samples of accounts with $E \ X = 5, \ \text{Var} \ X = 9$.

13. Determine $E (X_1 + X_2 + \ldots + X_{100})$.
    \[
    100 \ E \ X = 500 \text{ (on the average, the total of 100 plays is 500)}
    \]

14. Determine $sd (X_1 + X_2 + \ldots + X_{100})$ (first get the variance).
    \[
    \text{Var}(\text{total of 100 indep plays}) = 100 \ \text{Var} \ X = 900
    \]
    \[
    \text{sd}(\text{total of 100 independent plays}) = 30 \text{ (root of variance)}
    \]

data \{3, 4, 5\}

15. Determine the sample sd $s$ for the above data.
    mean is 4
    root of \[
    \frac{1}{3-1} ((3-4)^2 + (4-4)^2 + (5-4)^2)
    \]
    \[
    = \sqrt{1} = 1
    \]

16. Determine the sample mean ± margin of error.
    \[
    4 \pm 1.96 \ s / \sqrt{n}
    \]
    \[
    4 \pm 1.96 \ 1 / \sqrt{3}
    \]

The expected number of raisins in a cookie is 4 and the mix is random.

17. Sketch the normal approximation of the distribution of the number of raisins in a cookie (w/ labels).
    mean 4, \ sd = \sqrt{\text{mean}} = 2 \text{ (for Poisson) (draw normal curve)}

18. Determine $p(2)$, the probability that a cookie contains exactly two raisins.
    $p(2) = e^{-\text{mean}} \text{mean}^2 / 2! = e^{-4} \ 4^2 / 2! = 8 \ e^{-4}$
A with – repl sample of 400 voters will be selected from a population of which 20 % favor a particular ballot proposal. Let \( r.v. X \) denote the number of voters in the sample favoring this proposal.

19. Determine the mean and s.d. of \( X \).
   - Binomial \( n = 400, p = 0.2 \) is the distribution of \( X \).
   - mean = \( np = 80 \)
   - var = \( npq = 400 \times 0.2 \times 0.8 = 64 \)
   - sd = \( \text{root var} = 8 \)

20. Determine the probability that a customer waits longer than 10 minutes. You need not compute it.
   - \( e^{-x/\text{mean}} = e^{-10/5} = e^{-2} \)

21. Determine the density portrait for the above data using the figure below.

ans. Obtain the average height of the two curves (midway between them) at a few points on the horizontal axis then join these with a smooth curve.