Formulas for Math 1320

Equation of a linear function: $y = mx + b$ **or** $f(x) = mx + b$**, where** $m = \frac{y_2 - y_1}{x_2 - x_1}$**.**

Cost function: $C(x) = mx + b$, **where** m **is the marginal cost and** b **is the fixed cost, and** $m = \frac{C_2 - C_1}{x_2 - x_1}$**.**
Revenue: $R(x) = mx$**, where** m **is the marginal revenue. Also,** $R = (\text{price}) \times (\text{quantity})$**.**
Profit: $P(x) = R(x) - C(x)$**.**
Supply and demand: Both have the form $q = mp + b$**. For demand,** $m < 0$**; for supply** $m > 0$**. In both cases,** $m = \frac{q_2 - q_1}{p_2 - p_1}$**.**
Parabolas: Functions have the form $f(x) = ax^2 + bx + c$**.**
Vertex at the point $\left(-\frac{b}{2a}, f\left(\frac{-b}{2a}\right)\right)$**.**
y**-intercept at** $(0, c)$
To find x**-intercepts, solve** $ax^2 + bx + c = 0$ **for** x**.**
Exponential Growth and Decay: Formulas are $Q(t) = Q_0 e^{kt}$ **(growth) and** $Q(t) = Q_0 e^{-kt}$ **(decay), where** Q_0 **is the quantity at time** $t = 0$**. For growth,** $k = \frac{\ln(2)}{\text{doubling time}}$ **and for decay,** $k = \frac{\ln(2)}{\text{half-life}}$**.**
Alternate form for exponential functions is $y = Ab^x$**.**
Simple Interest: $INT = PV\, rt$**.**
Future Value for Simple Interest: $FV = PV + INT = PV + PV\, rt = PV(1 + rt)$.
Present Value for Simple Interest: $PV = \frac{FV}{1+rt}$**.**
Future Value for Compound Interest:

$$FV = PV\left(1 + \frac{r}{m}\right)^{mt} \qquad \text{or} \qquad FV = PV(1+i)^n$$

where $i = r/m$ is the interest paid each compounding period and $n = mt$ is the total number of compounding periods.

Present Value for Compound Interest

$$PV = \frac{FV}{\left(1 + \frac{r}{m}\right)^{mt}} \qquad \text{or} \qquad PV = \frac{FV}{(1+i)^n} = FV(1+i)^{-n}$$

Effective Interest Rate

$$r_{\text{eff}} = \left(1 + \frac{r_{\text{nom}}}{m}\right)^m - 1$$

Sinking Fund:

$$FV = PMT\,\frac{(1+i)^n - 1}{i}$$

where $i = r/m$ is the interest paid each compounding period and $n = mt$ is the total number of compounding periods.

Payment Formula for a Sinking Fund

$$PMT = FV\,\frac{i}{(1+i)^n - 1}$$

where $i = r/m$ is the interest paid each compounding period and $n = mt$ is the total number of compounding periods.

Present Value of an Annuity

$$PV = PMT\,\frac{1 - (1+i)^{-n}}{i}$$

where $i = r/m$ is the interest paid each compounding period and $n = mt$ is the total number of compounding periods.

Payment Formula for an Ordinary Annuity

$$PMT = PV \frac{i}{1-(1+i)^{-n}}$$

where $i = r/m$ is the interest paid each compounding period and $n = mt$ is the total number of compounding periods.

Set Operations

1. Union : $A \cup B = \{x | x \in A \text{ or } x \in B\}$
2. Intersection : $A \cap B = \{x | x \in A \text{ and } x \in B\}$
3. Complement : $A' = \{x \in S | x \notin A\}$
4. Cartesian Product : $A \times B = \{(a, b) | a \in A \text{ and } b \in B\}$ where $A \times B$ is the set of all ordered pairs whose first component is in A and whose second component is in B.

Cardinality

If A is a finite set, then its cardinality is $n(A) =$ the number of elements in A.

1. Union : $n(A \cup B) = n(A) + n(B) - n(A \cap B)$
2. Complement : $n(A') = n(S) - n(A)$
3. Cartesian Product : $n(A \times B) = n(A)n(B)$

Permutations

$$n! = n \times (n-1) \times (n-2) \times \cdots \times 2 \times 1 \qquad \text{and} \qquad 0! = 1.$$

Permutations of n items taken r at a time

A permutation of n items taken r at a time is an ordered list of r items chosen from a set of n items.

$$P(n, r) = \frac{n!}{(n-r)!} = n \times (n-1) \times (n-2) \times \cdots \times (n-r+1).$$

Combinations of n items taken r at a time

A Combinations of n items taken r at a time is an unordered set of r items chosen from a set of n items.

$$C(n, r) = \frac{P(n, r)}{r!} = \frac{n!}{r!\,(n-r)!}$$

Relative frequency or Estimated Probability

$$P(E) = \frac{fr(E)}{N} = \frac{\text{Frequency of event E}}{\text{Total number of experiments}}$$

Probability Model for Equally Likely Outcomes

$$P(E) = \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}} = \frac{n(E)}{n(S)}.$$

Probability of the Complement of an Event

$$P(A') = 1 - P(A) \qquad \text{(The probability of } A \textit{ not} \text{ happening is 1 minus the probability of } A\text{)}$$

Addition Principle: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$.

If $A \cap B = \emptyset$, we say that A and B are **mutually exclusive**, we have $P(A \cup B) = P(A) + P(B)$.

Conditional Probability: If A and B are events with $P(B) \neq 0$, then the probability of A given B is

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}.$$

Multiplication Principle for Conditional Probability: If A and B are events, then $P(A \cap B) = P(A \mid B)P(B)$.

Independent Events: The events are independent if $P(A \cap B) = P(A)P(B)$