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Q.1 Implementation of Relative Entropy

```
#include <bits/stdc++.h>
using namespace std;

double kl_divergence(const vector<double>& P, const
vector<double>& Q) {
    double kl = 0.0;
    int n = P.size();
    for (int i = 0; i < n; i++) {
        if (P[i] > 0 && Q[i] > 0) {
            kl += P[i] * log(P[i] / Q[i]);
        } else if (P[i] > 0 && Q[i] == 0) {
            return -1;
        }
    }
    return kl;
}

int main() {
    vector<double> P = {0.2, 0.5, 0.3};
    vector<double> Q = {0.1, 0, 0.3};
    double result = kl_divergence(P, Q);
    if (result != -1) {
        cout << "KL Divergence: " << result << endl;
    }
    else{
                cout<<"Kl divergence is undefined"<<endl;
```

```
        }
    return 0;
}
```

```
Output

KL Divergence: 0.596775


=== Code Execution Successful ===
```

Q.2 Implementation of Jensen's Inequality

```
#include <bits/stdc++.h>
using namespace std;

double jensens_inequality(const vector<double>& P, const
vector<double>& X) {
    double expected_value = 0.0;
    double function_expected_value = 0.0;
    int n = P.size();

    for (int i = 0; i < n; i++) {
        expected_value += P[i] * X[i];
        function_expected_value += P[i] * log(X[i]);
    }

    double log_expected_value = log(expected_value);

    cout << "E[f(X)] = " << function_expected_value << endl;
```

```
    cout << "f(E[X]) = " << log_expected_value << endl;

    return function_expected_value <= log_expected_value;
}

int main() {
    vector<double> P = {0.2, 0.5, 0.3}; // Probabilities
        for(int i=0;i<P.size();i++){
                if (P[i] < 0 || P[i] > 1) {
            cerr << "Error: Probabilities must be in the range [0,1]." <<
endl;
                        break;
        }
        }
    vector<double> X = {2.0, 3.0, 4.0}; // Random variable values
        //NOTE::
    // I'm Applying log as a convex function
    bool fl = jensens_inequality(P, X);
    if (fl) {
        cout << "Jensen's Inequality holds!" << endl;
    } else {
        cout << "Jensen's Inequality does NOT hold!" << endl;
    }
    return 0;
}

```
```
```

Output

```
E[f(X)] = 1.10382
f(E[X]) = 1.1314
Jensen's Inequality holds!


=== Code Execution Successful ===
```

NOTE: All the above programs was run on programmiz online cpp compiler

THANK YOU