# Exercise – Sequences, Series, and Loops

**An arithmetic series is the sum of a sequence of numbers (for example: 1 + 2 + 3 + … + 10 = 55)**

1. **Using a counted loop, output the numbers from 1 to 100. In addition, keep a running total of the numbers from 1 to 100 (the arithmetic series) and output the total (i.e. 1+2+3+…+100).**

```
int total=1;
for (int n=1; n<100; n++,total=total+n) {
   System.out.print(" " + n);
         }
System.out.println("\n" + total);
```

2. **Write a program that will prompt the user for the first value (first), last value (last), and common difference (diff) of an arithmetic sequence. Output the sum of the sequence.**

```
Scanner input = new Scanner(System.in);
int first,last,diff,sum,value;
sum=0;
value=1;
System.out.println("Enter first value:");
first = input.nextInt();
System.out.println("Enter last value:");
last = input.nextInt();
System.out.println("Enter the common difference:");
diff = input.nextInt();
for(;value<=last;value+=diff) {
   sum=sum+value;
}
System.out.println("The sum is " + sum);
```

3. **Write a program that will print the arithmetic sequence staring at 10, with a common difference of 12, stopping at the first value over 1023.**

```
for (int value=10; value<=1023; value+=12)
     System.out.println(value);
```

4. **Write a program that will print the arithmetic sequence staring at 1000, with a common difference of -76, stopping at the first value below 1.**

```
for(int value=1000; value>-76; value-=76)
    System.out.println(value);
```

5. **Output the number of terms of a sequence that starts at 0 and ends at 1000, jumping by 56.**

```
int term=0;
for(int value=0; value<=1000; value+=56) {
   term++;
         }
System.out.println(term);
```

6. **Output the number of terms of a sequence that starts at 6413 and ends at 1000, jumping by -3.**

```
int term=0;
for (int value=6413; value>=1000; value-=3)
      term++;
System.out.println(term);
```

7. **Using a counted loop, output the arithmetic series for a sequence of 100 terms. The first value is 2 and the common difference is 3. Hint: Create a variable to keep track of the current term in the sequence (initialize it to 2).**

```
for(int value=2,diff=3,term=0; term<=100; value+=3,term++)
   System.out.println(value);
```

8. **Find the value of the 125th term of an arithmetic sequence that starts at 5 and has a common difference of 7.**

```
int value=5;
for (int term=1; term<125; value+=7)
     term++;
System.out.println(value);
```

9. **Find the value of the 51st term of an arithmetic sequence that starts at 200 and has a common difference of -4.**

```
int value=200;
for (int term=1; term<51; value-=4)
    term++;
    System.out.println(value);
```

10. **Write a program that determines the 1st term in an arithmetic sequence of 32 terms that ends at 100 and has been jumping by 5.**

```
int value=100;
for (int term=32; term>1; value+=5)
     term--;
System.out.println("The first term is " + value);
```

11. **An arithmetic series can be modeled with the formula $s_n = (n/2)\,[2a + (n-1)\,d]$ where n is the number of terms in a sequence, a is the first value, and d is the difference between terms (amount of the step). Create variables for each of n, a, d and prompt the user for their values. Calculate the sum using the formula.**

```
Scanner input = new Scanner(System.in);
System.out.println("Enter the number of terms:");
int n = input.nextInt();
System.out.println("Enter the first value:");
int a = input.nextInt();
System.out.println("Enter the difference between terms ");
int d = input.nextInt();
int Sn = ((n/2)*(2*a + (n-1)*d));
System.out.println("The sum is " + Sn);
```

12. **Modify the previous question to determine the sum using repetition. You must keep the variables. Use the following for loop to move along the sequence where c represents the term number: for (int c=1; c<=n; c=c+1){}**

**A geometric series is the sum of a geometric sequence of numbers (for example: $4 + 8 + 16 + 32 = 60$ or $2^2 + 2^3 + 2^4 + 2^5 = 60$)**

13. **Write a program that will prompt the user for the first term (first), last term (last), and common ratio (rat) of a geometric sequence. Output the sequence up until the last term and the sum of the sequence.**

```
Scanner input = new Scanner(System.in);
System.out.println("Enter first value:");
int first = input.nextInt();
System.out.println("Enter last value");
int last = input.nextInt();
System.out.println("Enter common ratio:");
int rat = input.nextInt();
int sum =0;
for (; first<=last;first*=rat) {
   sum=sum+first;
   System.out.println(first);
         }
System.out.println("The sum is " + sum);
```

14. **A geometric series can be modeled with the formula $s_n = [a(r^n - 1)]/[r-1]$ , where a is the first number of the sequence, n is the number of terms in the sequence, and r is the multiplier between the terms (also r can not be 1). Create variables for each of r, a, n and prompt the user for their values. Calculate the sum using the formula.**

```
Scanner input = new Scanner(System.in);
System.out.println("Enter the first number:");
int a = input.nextInt();
System.out.println("Enter the number of terms:");
int n = input.nextInt();
System.out.println("Enter the multiplier:");
int r = input.nextInt();
int Sn = (int) (a*(Math.pow(r,n)-1))/(r-1);
System.out.println("The sum is " + Sn);
```

15. **Modify the previous question to determine the sum using repetition. You must keep the variables. Use the following for loop to move along the sequence where c represents the term number: for (int c=1; c<=n; c=c+1){}**

```
Scanner input = new Scanner(System.in);
System.out.println("Enter the first number:");
int a = input.nextInt();
System.out.println("Enter the number of terms:");
int n = input.nextInt();
System.out.println("Enter the multiplier:");
int r = input.nextInt();
int sum=0;
for (int c=1; c<=n; a*=r,c=c+1)
     sum=sum+a;
System.out.println(sum);
```

**16. Suppose that a large piece of paper with an area of 1.0 $m^2$ and a thickness of 0.090 mm is cut in half and the two pieces are stacked, one on top of the other. Suppose further that the process of cutting in half and stacking is repeated over and over again.**

**Write a program to find both the thickness of the pile and the area of each piece after the procedure has been carried out forty times.**

**Assume that the input is valid**

```
double area=1.0;
double thickness=0.090;
for (double term=1.0; term<49; term++) {
      area/=2;
       thickness+=0.090;
 }
System.out.println("The area of each piece is " + area + "m2");
System.out.println("The thickness of pile is " +
Math.round(thickness*100)/100.0 + "mm");
```

**17. The interest earned on the money in your savings account can be calculated with the formula (interest = moneyInAccount * interestRate). After calculating the interest, the money in your account would equal (moneyInAccount = moneyInAccount + interest). These formulas can be combined by following a little mathematical logic (see if you can do it). Write a program that uses a for loop to determine the interest after 5 years. Assume you start with $100 and the interest rate is 5%.**

```
double moneyInAccount=100;
double interest=5;
double totalInterest=0;
for (double interestRate=0.05,year=1; year<=5; year++) {
     interest = moneyInAccount * interestRate;
     totalInterest = totalInterest + interest;
     moneyInAccount = moneyInAccount+interest;
}
System.out.println("The total interest earned is $" +
Math.round(moneyInAccount*100)/100.0);
```

**a) Modify so it prompts for the initial balance and interest rate.**

```
Scanner input = new Scanner(System.in);
System.out.println ("Enter money in the Account:");
double moneyInAccount = input.nextDouble();
System.out.println("Enter interest rate:");
double interestRate = input.nextDouble();
double totalInterest=0;
for (Double interest=0.0,year=1.0; year<=5; year++) {
       interest = moneyInAccount * interestRate;
       totalInterest = totalInterest + interest;
       moneyInAccount = moneyInAccount+interest;
}
System.out.println("The total interest earned is $" +
Math.round(totalInterest*100)/100.0);
```

```
System.out.println("After 5 years there are $" +
Math.round(moneyInAccount*100)/100.0 + " in the account");
```

18. **$1000 is deposited in a bank account for 10 years, and collects interest at an annual rate of 4%. Write a program which outputs the following data in a neat table for the ten year period: year, starting balance, interest earned, ending balance**

```
double moneyInAccount=1000;
double interest=40;
double totalInterest=0;
double startingBalance=0;
for (double interestRate=0.04,year=1; year<=10;  year++) {
     startingBalance=moneyInAccount;
     interest = moneyInAccount * interestRate;
     totalInterest = totalInterest + interest;
     moneyInAccount = moneyInAccount+interest;
     System.out.println(year + "\t\t" +
Math.round(startingBalance*100)/100.0 + "\t\t" +
Math.round(interest*100)/100.0 + "\t\t" +
Math.round(moneyInAccount*100)/100.0);
```

    a. **Modify so that it is interactive! Have the program ask the user how much to deposit, what the interest rate is, and how many years the money should be left in the account. Then generate a table based on these numbers.**

```
Scanner input = new Scanner(System.in);
System.out.println("Enter amount to deposit:");
double moneyInAccount = input.nextDouble();
System.out.println("Enter interest rate:");
double interestRate = input.nextDouble();
System.out.println("Enter how many years the money should be left in the
account:");
double years = input.nextDouble();
double totalInterest=0;
double startingBalance=0;
for (double time=1; time<=years; time++) {
     startingBalance=moneyInAccount;
     double interest = moneyInAccount * interestRate;
     totalInterest = totalInterest + interest;
     moneyInAccount = moneyInAccount+interest;
     System.out.println(time              +             "\t\t"             +
Math.round(startingBalance*100)/100.0          +          "\t\t"          +
Math.round(interest*100)/100.0            +            "\t\t"            +
Math.round(moneyInAccount*100)/100.0);
```

19. **A homeowner takes out a mortgage for $225,000 at an annual interest rate of 6.75%. A payment of $25,000 is made at the end of each year. Output a neat table that displays the first ten years data : year, beginning balance, interest payable, principal payment, ending balance.**

```
double mortgage = 225000;
double interestRate = 0.0675;
double principalPayment = 25000;
```

```
for (double year=1,endingBalance=0; year<=10;
year++,mortgage=endingBalance) {
     double interest = mortgage*interestRate;
     endingBalance = mortgage-principalPayment;
     System.out.println(year + "\t\t" + Math.round(mortgage*100)/100.0 +
"\t\t" + Math.round(interest*100)/100.0 + "\t\t" + principalPayment +
"\t\t" + Math.round(endingBalance*100)/100.0);
```

**a. Modify the above so that it is interactive! Ask the user how much should be borrowed, what the interest rate is, how much should be paid back every year, ...**

```
Scanner input = new Scanner(System.in);
System.out.println("Enter how much should be borrowed:");
double mortgage = input.nextDouble();
System.out.println("Enter interest rate:");
double interestRate = input.nextDouble();
System.out.println("how much should be paid back every year:");
double principalPayment = input.nextDouble();
for (double year=1,endingBalance=0; year<=10;
year++,mortgage=endingBalance) {
     double interest = mortgage*interestRate;
     endingBalance = mortgage-principalPayment;
     System.out.println(year + "\t\t\t" + Math.round(mortgage*100)/100.0 +
"\t\t\t" + Math.round(interest*100)/100.0 + "\t\t\t" + principalPayment +
"\t\t\t" + Math.round(endingBalance*100)/100.0);
```