```
> with(LinearAlgebra);
```

[*&x*, *Add*, *Adjoint*, *BackwardSubstitute*, *BandMatrix*, *Basis*, *BezoutMatrix*, *BidiagonalForm*, *BilinearForm*, *CARE*, *CharacteristicMatrix*, *CharacteristicPolynomial*, *Column*, *ColumnDimension*, *ColumnOperation*, *ColumnSpace*, *CompanionMatrix*, *CompressedSparseForm*, *ConditionNumber*, *ConstantMatrix*, *ConstantVector*, *Copy*, *CreatePermutation*, *CrossProduct*, *DARE*, *DeleteColumn*, *DeleteRow*, *Determinant*, *Diagonal*, *DiagonalMatrix*, *Dimension*, *Dimensions*, *DotProduct*, *EigenConditionNumbers*, *Eigenvalues*, *Eigenvectors*, *Equal*, *ForwardSubstitute*, *FrobeniusForm*, *FromCompressedSparseForm*, *FromSplitForm*, *GaussianElimination*, *GenerateEquations*, *GenerateMatrix*, *Generic*, *GetResultDataType*, *GetResultShape*, *GivensRotationMatrix*, *GramSchmidt*, *HankelMatrix*, *HermiteForm*, *HermitianTranspose*, *HessenbergForm*, *HilbertMatrix*, *HouseholderMatrix*, *IdentityMatrix*, *IntersectionBasis*, *IsDefinite*, *IsOrthogonal*, *IsSimilar*, *IsUnitary*, *JordanBlockMatrix*, *JordanForm*, *KroneckerProduct*, *LA_Main*, *LUDecomposition*, *LeastSquares*, *LinearSolve*, *LyapunovSolve*, *Map*, *Map2*, *MatrixAdd*, *MatrixExponential*, *MatrixFunction*, *MatrixInverse*, *MatrixMatrixMultiply*, *MatrixNorm*, *MatrixPower*, *MatrixScalarMultiply*, *MatrixVectorMultiply*, *MinimalPolynomial*, *Minor*, *Modular*, *Multiply*, *NoUserValue*, *Norm*, *Normalize*, *NullSpace*, *OuterProductMatrix*, *Permanent*, *Pivot*, *PopovForm*, *ProjectionMatrix*, *QRDecomposition*, *RandomMatrix*, *RandomVector*, *Rank*, *RationalCanonicalForm*, *ReducedRowEchelonForm*, *Row*, *RowDimension*, *RowOperation*, *RowSpace*, *ScalarMatrix*, *ScalarMultiply*, *ScalarVector*, *SchurForm*, *SingularValues*, *SmithForm*, *SplitForm*, *StronglyConnectedBlocks*, *SubMatrix*, *SubVector*, *SumBasis*, *SylvesterMatrix*, *SylvesterSolve*, *ToeplitzMatrix*, *Trace*, *Transpose*, *TridiagonalForm*, *UnitVector*, *VandermondeMatrix*, *VectorAdd*, *VectorAngle*, *VectorMatrixMultiply*, *VectorNorm*, *VectorScalarMultiply*, *ZeroMatrix*, *ZeroVector*, *Zip*] **(1)**

```
> P:=Matrix(3);
```

$$P := \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \quad \textbf{(2)}$$

```
> a:=1/2:b:=3/10:c:=1/5:
  d:=2/5:e:=2/5:f:=1/5:
  g:=1/4:h:=7/20:i:=2/5:
  P(1,1):=a:
  P(1,2):=b:
  P(1,3):=c:
  P(2,1):=d:
  P(2,2):=e:
  P(2,3):=f:
  P(3,1):=g:
  P(3,2):=h:
  P(3,3):=i:
  P;
  Determinant(P);
```

$$\begin{bmatrix} \frac{1}{2} & \frac{3}{10} & \frac{1}{5} \\ \frac{2}{5} & \frac{2}{5} & \frac{1}{5} \\ \frac{1}{4} & \frac{7}{20} & \frac{2}{5} \end{bmatrix}$$

$$\frac{1}{50} \tag{3}$$

```
> A:= MatrixInverse(IdentityMatrix(3)-s*P);
```

$$A := \begin{bmatrix} -\frac{1}{2}\,\frac{9s^2-80s+100}{s^3-16s^2+65s-50} & \frac{5}{2}\,\frac{s(-6+s)}{s^3-16s^2+65s-50} & \frac{s}{s^2-6s+5} \\ \frac{1}{2}\,\frac{s(-40+11s)}{s^3-16s^2+65s-50} & -\frac{5}{2}\,\frac{3s^2-18s+20}{s^3-16s^2+65s-50} & \frac{s}{s^2-6s+5} \\ -\frac{1}{2}\,\frac{s(4s+25)}{s^3-16s^2+65s-50} & \frac{5}{2}\,\frac{s(-7+2s)}{s^3-16s^2+65s-50} & -\frac{4s-5}{s^2-6s+5} \end{bmatrix} \tag{4}$$

```
> sP:=unapply(A,s):
> sP(s);
```

$$\begin{bmatrix} -\frac{1}{2}\,\frac{9s^2-80s+100}{s^3-16s^2+65s-50} & \frac{5}{2}\,\frac{s(-6+s)}{s^3-16s^2+65s-50} & \frac{s}{s^2-6s+5} \\ \frac{1}{2}\,\frac{s(-40+11s)}{s^3-16s^2+65s-50} & -\frac{5}{2}\,\frac{3s^2-18s+20}{s^3-16s^2+65s-50} & \frac{s}{s^2-6s+5} \\ -\frac{1}{2}\,\frac{s(4s+25)}{s^3-16s^2+65s-50} & \frac{5}{2}\,\frac{s(-7+2s)}{s^3-16s^2+65s-50} & -\frac{4s-5}{s^2-6s+5} \end{bmatrix} \tag{5}$$

```
> g:=taylor(sP(s)(1,2),s,11);
```

$$g := \frac{3}{10}s + \frac{17}{50}s^2 + \frac{173}{500}s^3 + \frac{347}{1000}s^4 + \frac{17359}{50000}s^5 + \frac{173607}{500000}s^6 + \frac{1736103}{5000000}s^7 + \frac{3472219}{10000000}s^8 + \frac{173611079}{500000000}s^9 + \frac{1736111047}{5000000000}s^{10} + O(s^{11}) \tag{6}$$

```
> coeff(convert(g,polynom),s^6);
```

$$\frac{173607}{500000} \tag{7}$$

```
> X:=Matrix(3):
  for j from 1 to 3 do for k from 1 to 3 do
  X(j,k):=limit((1-s)*sP(s)(j,k),s=1);
  od:
  od:
  X;
```

$$\begin{bmatrix} \frac{29}{72} & \frac{25}{72} & \frac{1}{4} \\ \frac{29}{72} & \frac{25}{72} & \frac{1}{4} \\ \frac{29}{72} & \frac{25}{72} & \frac{1}{4} \end{bmatrix} \tag{8}$$

```
> P:=Matrix(4):
  P(1,2):=p:   P(1,4):=1-p:
  P(2,1):=1-p:   P(2,3):=p:
  P(3,2):=1-p:   P(3,4):=p:
  P(4,1):=p:   P(4,3):=1-p:
  P;
```

$$\begin{bmatrix} 0 & p & 0 & 1-p \\ 1-p & 0 & p & 0 \\ 0 & 1-p & 0 & p \\ p & 0 & 1-p & 0 \end{bmatrix} \tag{9}$$

```
> A:= MatrixInverse(IdentityMatrix(4)-s*P):
  sP:=unapply(A,s):
  sP(s);
```

$$\left[\left[-\frac{2p^2s^2-2ps^2+1}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1}, -\frac{s\left(2p^2s^2-3ps^2+s^2+p\right)}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1}, -\frac{\left(2p^2-2p+1\right)s^2}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1}, -\frac{s\left(2p^2s^2-ps^2-p+1\right)}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1} \right], \left[-\frac{s\left(2p^2s^2-ps^2-p+1\right)}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1}, -\frac{2p^2s^2-2ps^2+1}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1}, -\frac{s\left(2p^2s^2-3ps^2+s^2+p\right)}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1}, -\frac{\left(2p^2-2p+1\right)s^2}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1} \right], \left[-\frac{\left(2p^2-2p+1\right)s^2}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1}, -\frac{s\left(2p^2s^2-ps^2-p+1\right)}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1}, -\frac{2p^2s^2-2ps^2+1}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1}, -\frac{s\left(2p^2s^2-3ps^2+s^2+p\right)}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1} \right], \left[-\frac{s\left(2p^2s^2-3ps^2+s^2+p\right)}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1}, -\frac{\left(2p^2-2p+1\right)s^2}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1}, -\frac{s\left(2p^2s^2-ps^2-p+1\right)}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1}, -\frac{2p^2s^2-2ps^2+1}{4p^2s^4-4ps^4-4p^2s^2+s^4+4ps^2-1} \right] \right] \tag{10}$$

```
> sP1:=Matrix(4):
  for j from 1 to 4 do for k from 1 to 4 do
  sP1(j,k):=limit((1-s)*sP(s)(j,k),s=1);
  od:
  od:
  sP1;
```

$$\begin{bmatrix} \frac{1}{4} & \frac{1}{4} & \frac{1}{4} & \frac{1}{4} \\ \frac{1}{4} & \frac{1}{4} & \frac{1}{4} & \frac{1}{4} \\ \frac{1}{4} & \frac{1}{4} & \frac{1}{4} & \frac{1}{4} \\ \frac{1}{4} & \frac{1}{4} & \frac{1}{4} & \frac{1}{4} \end{bmatrix} \tag{11}$$