Unit 15, part 61

Cadenzas for Unit 15, part 58, π/2 variations
calculated by Dr. Dagmar Schönfeld with Mathematica®

```
(* Pi/2 variations *)

In[511]:= n1 = 40; genau = 50; det1 = Table[0, {i, n1}]; det1[[1]] = 1/2!;
matrix1 = {{1/2!, 1/0!}, {1/4!, 1/2!}}; det1[[2]] = Det[matrix1];
m = matrix1; dim = 2;
Table[{matrix1 = Table[0, {i, dim + 1}, {j, dim + 1}];
   Table[Table[matrix1[[i, j]] = m[[i, j]], {i, 1, dim}], {j, 1, dim}];
   matrix1[[dim, dim + 1]] = 1/0!;
   dim++; nenner = 2 * dim; Table[
    {matrix1[[dim, j]] = 1/nenner!; nenner -= 2;}, {j, 1, dim}];
   det1[[dim]] = Det[matrix1]; m = matrix1; (*Print[TableForm[matrix1]];*)
   If[dim == 6, Print[TableForm[matrix1]]];}, {k, 3, n1}];
(*Print["det1=\n",det1];*)Print[N[det1, genau]];
```

$$
\begin{pmatrix}
\frac{1}{2} & 1 & 0 & 0 & 0 & 0 \\
\frac{1}{24} & \frac{1}{2} & 1 & 0 & 0 & 0 \\
\frac{1}{720} & \frac{1}{24} & \frac{1}{2} & 1 & 0 & 0 \\
\frac{1}{40\,320} & \frac{1}{720} & \frac{1}{24} & \frac{1}{2} & 1 & 0 \\
\frac{1}{3\,628\,800} & \frac{1}{40\,320} & \frac{1}{720} & \frac{1}{24} & \frac{1}{2} & 1 \\
\frac{1}{479\,001\,600} & \frac{1}{3\,628\,800} & \frac{1}{40\,320} & \frac{1}{720} & \frac{1}{24} & \frac{1}{2}
\end{pmatrix}
$$

{0.50000000000000000000000000000000000000000000000000,
0.20833333333333333333333333333333333333333333333333,
0.084722222222222222222222222222222222222222222222222,
0.034350198412698412698412698412698412698412698412698,
0.013922233245149911816578483245149911816578483245150,
0.0056424968100315322537544759766981989204211426433649,
0.0022868190951648292918134187975457816727657997499267,
0.00092681292737742183840067437951035834633718231601829,
0.00037562313385259449777077815947684882913295265890625,
0.00015223432221797661869635672152130327343232518297996,
0.000061698246877700525175340078657815857643905507073851,
0.000025005357609459247378161575147115669223288718214691,
0.000010134289721572026294325570199395198531819054005414,
4.1072729198567003648045606314886849552932486154326 $\times 10^{-6}$,
1.6646150151280279817642045433185453995798592675153 $\times 10^{-6}$,
6.7464305456632013366856879688472424551034092274003 $\times 10^{-7}$,
2.7342253129896734008097635939306280684798924989787 $\times 10^{-7}$,
1.1081397802278206993874774070221437378644571976994 $\times 10^{-7}$,
4.4911213669537135950127692573877920581174948859943 $\times 10^{-8}$,
1.8201829311245770316908982651729764931302138928770 $\times 10^{-8}$,
7.3769235610848765131517624681962208232659223304293 $\times 10^{-9}$,
2.9897545073926763682503296671067569983001855505835 $\times 10^{-9}$,
1.2117018619561618504410542868724844554474473779826 $\times 10^{-9}$,
4.9108426750009154595792428498961597869324040593065 $\times 10^{-10}$,
1.9902895700495880808765883432191928964794261178429 $\times 10^{-10}$,
8.0663398011369519988306049797186698543548179942326 $\times 10^{-11}$,
3.2691643852499818124284285771576197775695456431795 $\times 10^{-11}$,
1.3249424201396146946756240624453340788630852517061 $\times 10^{-11}$,
5.3697893706595738989063349343354434276007432238531 $\times 10^{-12}$,
2.1762936597810882207424599328250696858690804957104 $\times 10^{-12}$,
8.8201859824933999593687918352763429253972741955443 $\times 10^{-13}$,
3.5746867347671487251630115738528364417700812332734 $\times 10^{-13}$,
1.4487659644686841967631469824942759637981143540944 $\times 10^{-13}$,
5.8716272936280060092001635178339949241669691086165 $\times 10^{-14}$,
2.3796809091881836852853604232312251277549938693760 $\times 10^{-14}$,
9.6444834564008509027958089275527981125315995744866 $\times 10^{-15}$,
3.9087619176859165831591030357964669699173286953011 $\times 10^{-15}$,
1.5841615363041244398242978990447761087801430499735 $\times 10^{-15}$,
6.4203648775599250743565527372466659654703314514114 $\times 10^{-16}$,
2.6020758752402585169342687751632238477069470082418 $\times 10^{-16}$}

In[516]:=
```
n2 = 41; genau = 50; det2 = Table[0, {i, n2}]; det2[[1]] = 1/1!;
matrix2 = {{1/1!, 1/0!}, {1/3!, 1/2!}}; det2[[2]] = Det[matrix2];
m = matrix2; dim = 2;
Table[{matrix2 = Table[0, {i, dim + 1}, {j, dim + 1}];
   Table[Table[matrix2[[i, j]] = m[[i, j]], {i, 1, dim}], {j, 1, dim}];
   matrix2[[dim, dim + 1]] = 1/0!;
   dim++; matrix2[[dim, 1]] = 1/(2 * dim - 1)!; nenner = 2 * dim - 2;
   Table[{matrix2[[dim, j]] = 1/nenner!; nenner -= 2;}, {j, 2, dim}];
   det2[[dim]] = Det[matrix2]; m = matrix2; (*Print[TableForm[matrix1]];*)
   If[dim == 6, Print[TableForm[matrix2]]];}, {k, 3, n2}];
Print[N[det2, genau]];
```

$$\begin{array}{cccccc} 1 & 1 & 0 & 0 & 0 & 0 \\ \frac{1}{6} & \frac{1}{2} & 1 & 0 & 0 & 0 \\ \frac{1}{120} & \frac{1}{24} & \frac{1}{2} & 1 & 0 & 0 \\ \frac{1}{5040} & \frac{1}{720} & \frac{1}{24} & \frac{1}{2} & 1 & 0 \\ \frac{1}{362\,880} & \frac{1}{40\,320} & \frac{1}{720} & \frac{1}{24} & \frac{1}{2} & 1 \\ \frac{1}{39\,916\,800} & \frac{1}{3\,628\,800} & \frac{1}{40\,320} & \frac{1}{720} & \frac{1}{24} & \frac{1}{2} \end{array}$$

$$\{1.000000000000000000000000000000000000000000000000,$$
$$0.333333333333333333333333333333333333333333333333,$$
$$0.133333333333333333333333333333333333333333333333,$$
$$0.053968253968253968253968253968253968253968253968254,$$
$$0.021869488536155202821869488536155202821869488536155,$$
$$0.008863235529902196568863235529902196568863235529902 2,$$
$$0.003592128036572481016925461369905814350258794703 2391,$$
$$0.001455834387051318268249485180702111919043135974 3529,$$
$$0.000590027440945585981378075993700021088754359840 57210,$$
$$0.000239129114243552481485731458885112809320569097 64432,$$
$$0.000096915379569294503255958750003888093778587554612151,$$
$$0.000039278323883316834053370808093123335095206563524462,$$
$$0.000015918905069328964740744279816570043055314793198975,$$
$$6.451689215655430763190842315302558044631824187253 0\times 10^{-6},$$
$$2.614771151290754554263594256409741097370429911135 5\times 10^{-6},$$
$$1.059726832010465435091355394124777619004445254151 5\times 10^{-6},$$
$$4.294911078273805854820351280397272242615311632802 9\times 10^{-7},$$
$$1.740661896357164777986229231330272921937402816294 0\times 10^{-7},$$
$$7.054636946400968325214518544480556569836911368192 4\times 10^{-8},$$
$$2.859136662305253908331094534141646943574928877692 4\times 10^{-8},$$
$$1.158764443279885220019793202909179039630692656854 0\times 10^{-8},$$
$$4.696295398230901628819043472467672382366197598144 2\times 10^{-9},$$
$$1.903336833931275921319706595462384034736965180745 5\times 10^{-9},$$
$$7.713933635359062290478933072162728548990192889820 5\times 10^{-10},$$
$$3.126339545892087045778120013440899955440043885071 7\times 10^{-10},$$
$$1.267057693030540106009628808122343862488850303486 3\times 10^{-10},$$
$$5.135191408039367740076049513054295176988901324761 4\times 10^{-11},$$
$$2.081214686770047419897227195060971086049374784159 7\times 10^{-11},$$
$$8.434845419094338293849148188558706453423987936841 4\times 10^{-12},$$
$$3.418514086811155814038680292485683222778375987353 8\times 10^{-12},$$
$$1.385471574294846899390054465352388234910699738697 8\times 10^{-12},$$
$$5.615104792414680083259101187776447999933263056450 7\times 10^{-13},$$
$$2.275716255372874845543374565376841527131746189945 3\times 10^{-13},$$
$$9.223130585139531735048796031077977698146054562796 1\times 10^{-14},$$
$$3.737994031096738885022389474057940901549434791804 8\times 10^{-14},$$
$$1.514951918714860507511088831107966431088566915658 6\times 10^{-14},$$
$$6.139868862616813824517465336969885287290797614893 8\times 10^{-15},$$
$$2.488395122276278938247260424729154160044382748549 0\times 10^{-15},$$
$$1.008508556635409648703845292961326113771290065457 8\times 10^{-15},$$
$$4.087331226869013761902422076555479989994323664337 1\times 10^{-16},$$
$$1.656532951378628367277014940374478565906208517232 9\times 10^{-16}\}$$

In[522]:=
```
y = Table[0, {i, n1}]; Table[y[[i]] = det1[[i]] / det2[[i + 1]], {i, 1, n1}]; Print[N[y, genau]];
```

```
{1.5000000000000000000000000000000000000000000000000000,
 1.5625000000000000000000000000000000000000000000000000,
 1.5698529411764705882352941176470588235294117647059,
 1.5706905241935483870967741935483870967741935483871,
 1.5707845287626628075253256150506512301013024602026,
 1.5707950141486220472440944881889763779527559055118,
 1.5707961808737100204503377371663641967406400170402,
 1.5707963105785365974118217238845564004020871307448,
 1.5707963249929623998442727007505108095039862938042,
 1.5707963265946770350178923838228599272635356470908,
 1.5707963267726498116495182325197781335040089518983,
 1.5707963267924247442320266848238625405555966943020,
 1.5707963267946219661538980953452745750466468585376,
 1.5707963267948661022107277329059230521464974768031,
 1.5707963267948932284507759942990225230425368326183,
 1.5707963267948962424779085362019833703279037382087,
 1.5707963267948965773698305734526874748924884185773,
 1.5707963267948966145800448700263505105933834859465,
 1.5707963267948966187145131546767716111061228452768,
 1.5707963267948966191738985208169605443877556895160,
 1.5707963267948966192249413393241429466307557494467,
 1.5707963267948966192306127636046052289239190178887,
 1.5707963267948966192312429218580653854194759275781,
 1.5707963267948966192313129394417861989255991876569,
 1.5707963267948966192313207191733108544932400973379,
 1.5707963267948966192313215835879247099412125496361,
 1.5707963267948966192313216796339929162952722172146,
 1.5707963267948966192313216903057782725645613563311,
 1.5707963267948966192313216914915322010392358943912,
 1.5707963267948966192313216916232826375364343173021,
 1.5707963267948966192313216916379215749250124143729,
 1.5707963267948966192313216916395481235237433338284,
 1.5707963267948966192313216916397288511458245478925,
 1.5707963267948966192313216916397489319927224605979,
 1.5707963267948966192313216916397511631979333397886,
 1.5707963267948966192313216916397514111096234374766,
 1.5707963267948966192313216916397514386553667816641,
 1.5707963267948966192313216916397514417160049310183,
 1.5707963267948966192313216916397514420560758365021,
 1.5707963267948966192313216916397514420938614926669}
```

--> y(n) Einbeziehung in step 1: T - Matrix * y(n)

In[524]:=
```
N[Pi / 2, 50]
```

Out[524]=
```
1.5707963267948966192313216916397514420985846996876
```

In[523]:=
```
N[(y[[30]] - y[[31]]) / (y[[31]] - y[[32]]), genau]
```

Out[523]=
```
8.9999999999989054798489456514496270643009302018 75
```

--> dy = 9

In[525]:=
```
(* T-Matrix *)
nT = 25; dy = 9; genau = 40; detT = Table[0, {i, nT}]; detT[[1]] = 1;
matrixT = {{1, 0}, {-1/dy, dy/(dy - 1)}}; detT[[2]] = Det[matrixT];
mT = matrixT; dim = 2;
Table[{matrixT = Table[0, {i, dim + 1}, {j, dim + 1}];
  Table[Table[matrixT[[i, j]] = mT[[i, j]], {i, 1, dim}], {j, 1, dim}]; dim++;
  i = dim - 1; If[Mod[dim, 2] == 0, vz = -1, vz = 1];
  Table[
   {matrixT[[dim, j + 1]] = vz (Product_{k=1}^{i-j} 1/(dy^k - 1)) Product_{m=1}^{j} dy^m/(dy^m - 1); vz *= -1;}, {j, 0, i - 1}];
  matrixT[[dim, dim]] = Product_{m=1}^{i} dy^m/(dy^m - 1);
  detT[[dim]] = Det[matrixT]; mT = matrixT;}, {k, 3, nT}];
Print[TableForm[matrixT]]; (*Print["detT=\n",N[detT,genau]];*)
```

1

$$-\frac{1}{9}$$

$$\frac{1}{640}$$

$$-\frac{1}{465\,920}$$

$$\frac{1}{3\,056\,435\,200}$$

$$-\frac{1}{180\,476\,385\,689\,600}$$

$$\frac{1}{95\,912\,370\,410\,881\,024\,000}$$

$$-\frac{1}{458\,745\,798\,479\,390\,789\,599\,232\,000}$$

$$\frac{1}{19\,747\,501\,938\,318\,761\,090\,457\,052\,119\,040\,000}$$

$$-\frac{1}{7\,650\,586\,837\,724\,400\,321\,220\,283\,274\,999\,910\,891\,520\,000}$$

$$\frac{1}{26\,675\,946\,836\,622\,770\,539\,385\,872\,686\,850\,599\,297\,942\,028\,288\,000\,000}$$

$$-\frac{1}{837\,119\,477\,779\,898\,199\,706\,574\,382\,499\,157\,774\,359\,241\,741\,434\,150\,191\,104\,000\,000}$$

$$\frac{1}{236\,427\,266\,087\,756\,308\,004\,714\,274\,857\,879\,354\,202\,669\,074\,037\,515\,048\,916\,206\,139\,473\,920\,000\,000}$$

$$-\frac{1}{600\,966\,388\,553\,479\,151\,785\,410\,147\,190\,589\,369\,147\,857\,133\,866\,836\,949\,160\,157\,757\,377\,074\,758\,953\,205\,760\,000\,000}$$

$$\frac{1}{13\,748\,183\,343\,344\,791\,568\,022\,131\,468\,258\,697\,921\,237\,284\,284\,696\,866\,207\,907\,642\,092\,607\,178\,125\,296\,558\,238\,072\,412\,569\,600\,000\,000}$$

$$-\frac{1}{2\,830\,629\,032\,806\,041\,859\,325\,029\,481\,382\,764\,083\,057\,340\,542\,831\,314\,543\,376\,640\,774\,743\,783\,244\,324\,030\,406\,543\,723\,166\,043\,050\,492\,087\,500\,800\,0}$$

$$\frac{1}{5\,245\,212\,744\,939\,752\,889\,007\,834\,380\,144\,865\,114\,567\,654\,543\,968\,869\,495\,460\,344\,023\,854\,148\,556\,786\,309\,075\,696\,348\,392\,871\,253\,780\,703\,585\,376\,045}$$

$$-\frac{1}{87\,475\,366\,000\,767\,092\,707\,112\,834\,995\,895\,127\,604\,595\,629\,107\,718\,953\,529\,474\,854\,336\,714\,436\,351\,756\,308\,066\,160\,683\,566\,689\,299\,170\,273\,799\,267}$$

$$\frac{1}{13\,129\,583\,157\,356\,653\,223\,791\,008\,731\,495\,035\,410\,576\,261\,784\,371\,061\,813\,427\,404\,408\,922\,246\,223\,579\,965\,955\,905\,577\,601\,391\,353\,315\,273\,231\,918\,05}$$

$$-\frac{1}{17\,736\,119\,960\,445\,621\,772\,370\,756\,007\,873\,102\,803\,187\,818\,433\,456\,788\,317\,280\,029\,557\,241\,561\,760\,200\,751\,213\,993\,791\,916\,350\,061\,815\,696\,886\,233}$$

$$\frac{1}{215\,629\,813\,020\,799\,878\,095\,734\,517\,571\,390\,494\,300\,093\,621\,552\,863\,203\,972\,104\,722\,989\,331\,570\,077\,866\,207\,361\,358\,757\,947\,553\,773\,670\,460\,367\,173\,2}$$

$$-\frac{1}{23\,593\,996\,167\,352\,944\,058\,503\,825\,268\,673\,132\,097\,979\,801\,146\,093\,490\,739\,618\,239\,433\,282\,926\,925\,269\,080\,682\,639\,198\,153\,588\,675\,772\,312\,009\,248}$$

$$\frac{1}{23\,234\,680\,891\,840\,824\,397\,702\,021\,644\,961\,190\,845\,069\,892\,178\,660\,292\,897\,753\,963\,612\,810\,164\,772\,277\,429\,895\,156\,982\,436\,149\,829\,962\,480\,280\,328\,04}$$

$$-\frac{1}{205\,927\,538\,974\,257\,613\,380\,241\,961\,993\,321\,192\,264\,522\,124\,954\,904\,333\,377\,541\,210\,277\,916\,102\,177\,953\,054\,634\,866\,274\,681\,414\,932\,749\,024\,027\,64}$$

$$\frac{1}{16\,426\,107\,315\,550\,565\,155\,947\,176\,989\,254\,644\,996\,934\,986\,601\,253\,246\,063\,605\,468\,192\,554\,651\,272\,953\,845\,560\,669\,208\,282\,351\,226\,056\,275\,546\,865\,85}$$

In[529]:=
```
nT = 25; yn = Table[0, {i, nT}]; verschiebe = 15; i = 0;
Table[yn[[++i]] = y[[j]], {j, 1 + verschiebe, nT + verschiebe}];
genau = 60; Print["yn=", N[yn, genau]];
(*Print["T(k=",nT,")*yn=",matrixT.yn];*)
yyn = matrixT.yn;
Print["yyn=T(k=", nT, ")*yn=", N[yyn, genau]];
diff = Table[0, {i, nT}];
Table[diff[[i]] = (yyn[[i]] - yyn[[i + 1]])/(yyn[[i + 1]] - yyn[[i + 2]]), {i, 1, nT - 2}];
Print["Differenzenquotient:\n", N[diff, genau]];
```

```
yn={1.57079632679489624247790853620198337032790373820870969560857,
  1.57079632679489657736983057345268747489248841857733677683450,
  1.57079632679489661458004487002635051059338348594646327493460,
  1.57079632679489661871451315467677161110612284527679008412097,
  1.57079632679489661917389852081696054438775568951599471299275,
  1.57079632679489661922494133932414294663075574944668894679065,
  1.57079632679489661923061276360460522892391901788871011853936,
  1.57079632679489661923124292185806538541947592757805697631387,
  1.57079632679489661923131293944178619892559918765692160335015,
  1.57079632679489661923132071917331085449324009733790366229597,
  1.57079632679489661923132158358792470994121254963608143795350,
  1.57079632679489661923132167963399291629527221721459588761941,
  1.57079632679489661923132169030577827256456135633114117743625,
  1.57079632679489661923132169149153220103923589439124718467090,
  1.57079632679489661923132169162328263753643431730213749908471,
  1.57079632679489661923132169163792157492501241437285145203368,
  1.57079632679489661923132169163954812352374333382837764658584,
  1.57079632679489661923132169163972885114582454789245398818382,
  1.57079632679489661923132169163974893199272246059788985228967,
  1.57079632679489661923132169163975116319793333978864871023670,
  1.57079632679489661923132169163975141110962343747656144493046,
  1.57079632679489661923132169163975143865536678166410932991553,
  1.57079632679489661923132169163975144171600493101828139815908,
  1.57079632679489661923132169163975144205607583650207829787150,
  1.57079632679489661923132169163975144209386149266694462019141}
```

```
yyn=T(k=25)*yn={1.5707963267948962424779085362019833703279037382087096956085 7,
  1.5926129424448257337101806688896085903287268333207583522045 2,
  1.5707963267948966192313216674604213013321570426894064487622 3,
  1.5707963267948966192313216907044592726523033654996926554129 0,
  1.5707963267948966192313216916024765550956558667538902544038 1,
  1.5707963267948966192313216916382610511685754133488202305842 5,
  1.5707963267948966192313216916396918291238029082712947794864 4,
  1.5707963267948966192313216916397490575909495019103245939139 7,
  1.5707963267948966192313216916397513467183200415411200857404 4,
  1.5707963267948966192313216916397514382833740960752216318258 0,
  1.5707963267948966192313216916397514419459762714173234588054 8,
  1.5707963267948966192313216916397514420924803624557763619025 6,
  1.5707963267948966192313216916397514420983405261961467625229 9,
  1.5707963267948966192313216916397514420985749327478527601517 1,
  1.5707963267948966192313216916397514420985843090099640069933 8,
  1.5707963267948966192313216916397514420985846840604493360252 3,
  1.5707963267948966192313216916397514420985846990624687671350 3,
  1.5707963267948966192313216916397514420985846996625495447457 4,
  1.5707963267948966192313216916397514420985846996865527758576 5,
  1.5707963267948966192313216916397514420985846996875129051022 8,
  1.5707963267948966192313216916397514420985846996875513102720 6,
  1.5707963267948966192313216916397514420985846996875528464788 6,
  1.5707963267948966192313216916397514420985846996875529079271 3,
  1.5707963267948966192313216916397514420985846996875529103850 6,
  1.5707963267948966192313216916397514420985846996875529104833 8}
```

Differenzenquotient:

```
{-1.0000000000000172691043916558417893494440665388579245470090 1,
  -9.3858974403878237511065101430946119596445146968357990414986 4×10^23,
  25.8837312218280108152990640221532065676520615401148294182575,
  25.0951496037117742393129793032423281568205188144873448725735,
  25.0105167906572763882086759392133120848041552716890472195468,
  25.0011581048027055474294235853110096168874356461122864607697,
  25.0001235768295420174264639860024553484048480107501038414038,
  25.0000111306249833024841474097565137023679142493359722564969,
  24.9999999101681186279328630719489487917407598987023429618556,
  24.9999993131985595949143507166127516257718008292358910323715,
  24.9999995783723421595824823185210232264295614737441228009243,
  24.9999977697065326441338054924789870669110045063490347594 05,
  24.9999988533027338200346597670802812997205361164511801593 91,
  24.9999994139734378441504585110868776050734059780046358699 67,
  24.9999997008983077401965593701997437305179880403435162367 82,
  24.9999998473850349164245379912375650982696648653750050425 65,
  24.9999999221338818133893767020842360127190908277629716332 16,
  24.9999999602722397858269400506929684596749234171697789714 55,
  24.9999999797307180417151630978496585400039723605375637743 61,
  24.9999999896585277752658392696626389744298498156230566297 29,
  24.9999999947237384567076451825677555596389858356247204864 40,
  24.9999999973080298021849618009911234696267435532361397004 96,
  24.9999999986265458149271974821928060380233479500016001708 37, 0, 0}
```

In[469]:= **N[Pi / 2, genau]**

Out[469]= 1.5707963267948966192313216916397514420985846996875529104874 7

--> dyy = 25

In[534]:=
```
(* T-Matrix *)
nT = 25; dyy = 25; genau = 40; detT = Table[0, {i, nT}]; detT[[1]] = 1;
matrixT = {{1, 0}, {-1/dyy, dyy/(dyy - 1)}}; detT[[2]] = Det[matrixT];
mT = matrixT; dim = 2;
Table[{matrixT = Table[0, {i, dim + 1}, {j, dim + 1}];
  Table[Table[matrixT[[i, j]] = mT[[i, j]], {i, 1, dim}], {j, 1, dim}]; dim++;
  i = dim - 1; If[Mod[dim, 2] == 0, vz = -1, vz = 1];
  Table[
   {matrixT[[dim, j + 1]] = vz (Product[1/(dyy^k - 1), {k, 1, i - j}]) Product[dyy^m/(dyy^m - 1), {m, 1, j}]; vz *= -1;}, {j, 0, i - 1}];
  matrixT[[dim, dim]] = Product[dyy^m/(dyy^m - 1), {m, 1, i}];
  detT[[dim]] = Det[matrixT]; mT = matrixT;}, {k, 3, nT}];
Print[TableForm[matrixT]]; (*Print["detT=\n",N[detT,genau]];*)
```

```
1
-1/25
1/14976
-1/233985024
1/91400166014976
-1/892579654839833985024
1/217914953902301689160166014976
-1/1330047325845938129350664710839833985024
1/202949115880923695556030391039325175289160166014976
-1/774189437411767935420978172981557217629743778824710839833985024
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1/10492223374464501136382696329895559966710168261737511493257960847913094764031581244125238621175289160166014976
-1/15634631178475173010440892599448512749100700113437933941423876218456781117672811641582836237237176874274761378
1/582435398492037244514420765059811350104475048811731310732335232793159215343982431716618540572960219871018888731
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1/12629554487550545473950133678877538027826451065547168701335188076711474763791336861263605346705152475811394743231
-1/7351368250995027759316209692896892779957077020598537322633469402984109856196778017034449121411783335826289749
1/106976487600987133327234320862258220992738760288834718287511227594766947158719990383484724269909741928036926690
-1/38917819474950059276028449155347876859355037564887007021360731042425550060200355011029409691551046672764983502
1/353955506170223627814525108543137479094325974363506558789891563758902012191837465978755988839627950133641905167
-1/80480164381293349791695870531289248518834931927009488577789127490334383333576070210895223950377755584463509223
1/457476769391253980027703792821256969879119213725840083801855736622211283103617754443702494870280861555667153204
-1/65011359053990813098906726398418776209459787479523870383535848648449379478890148017086340384439392079920390493
1/230966744588523955524219127249874211963703671661692841877965548030358009786523852622329761541166587818263193360
```

In[538]:=
```
nT = 25; genau = 70; Print["yyn=", N[yyn, genau]];
yyyn = matrixT.yyn;
Print["yyyn=T(k=", nT, ")*yyn=", N[yyyn, genau]];
diff = Table[0, {i, nT}];
Table[diff[[i]] = (yyyn[[i]] - yyyn[[i + 1]])/(yyyn[[i + 1]] - yyyn[[i + 2]]), {i, 1, nT - 2}];
Print["Differenzenquotient:\n", N[diff, genau]];
```

```
yyn={1.57079632679489624247790853620198337032790373820870969560856680329812 2,
  1.59261294244482573371018066888960859032872683332075835220452256115106 4,
  1.57079632679489661923132166746042130133215704268940644876222984124606 3,
  1.57079632679489661923132169070445927265230336549969265541290098276980 0,
  1.57079632679489661923132169160247655509565586675389025440381245363528 6,
  1.57079632679489661923132169163826105116857541334882023058424972942764 1,
  1.57079632679489661923132169163969182912380290827129477948643944961766 1,
  1.57079632679489661923132169163974905759094950191032459391396880359490 3,
  1.57079632679489661923132169163975134671832004154112008574043840243151 7,
  1.57079632679489661923132169163975143828337409607522163182580108515777 2,
  1.57079632679489661923132169163975144194597627141732345880548482035118 1,
  1.57079632679489661923132169163975144209248036245577636190256233216841 6,
  1.57079632679489661923132169163975144209834052619614676252299393622642 7,
  1.57079632679489661923132169163975144209857493274785276015171240672303 3,
  1.57079632679489661923132169163975144209858430900996400699338095971647 1,
  1.57079632679489661923132169163975144209858468406044933602523391085789 6,
  1.57079632679489661923132169163975144209858469906246876713502562554112 2,
  1.57079632679489661923132169163975144209858469966254954474574252181798 9,
  1.57079632679489661923132169163975144209858469968655277585764735139154 4,
  1.57079632679489661923132169163975144209858469968751290510227611971210 7,
  1.57079632679489661923132169163975144209858469968755131027206438422579 0,
  1.57079632679489661923132169163975144209858469968755284647885597835289 7,
  1.57079632679489661923132169163975144209858469968755290792712764341485 0,
  1.57079632679489661923132169163975144209858469968755291038505851004379 4,
  1.57079632679489661923132169163975144209858469968755291048337574470949 2}
```

```
yyyn=T(k=25)*yyn=
 {1.5707963267948962424779085362019833703279037382087096956085668032981 22,
  1.5961399619748976229156551886452629467793076351807748957220349957337 67,
  1.5698494250739795569457973776593909744238521136552945741634956044020 33,
  1.5707978442656032170875097876816340449451796800696127163800209936778 88,
  1.5707963266977227805122336940799985514587704448483578923079962397034 1,
  1.5707963267948968678702716284032948565951582698080742831646535767619 69,
  1.5707963267948966192312962310086707506310215428283397809770798032546 47,
  1.5707963267948966192313216916398557288512047508225119105292909762197 99,
  1.5707963267948966192313216916397514420985906801810521651110793984560 74,
  1.5707963267948966192313216916397514420985846120516892280951665851443 80,
  1.5707963267948966192313216916397514420985846954173374771120975431522 82,
  1.5707963267948966192313216916397514420985846995893757491368352588632 74,
  1.5707963267948966192313216916397514420985846996855002731348579231855 55,
  1.5707963267948966192313216916397514420985846996875108020545174696156 35,
  1.5707963267948966192313216916397514420985846996875520501633655219990 20,
  1.5707963267948966192313216916397514420985846996875528929255337653504 29,
  1.5707963267948966192313216916397514420985846996875529101290462598118 37,
  1.5707963267948966192313216916397514420985846996875529101480157394074 365,
  1.5707963267948966192313216916397514420985846996875529104873230120601 71,
  1.5707963267948966192313216916397514420985846996875529104874692495380 71,
  1.5707963267948966192313216916397514420985846996875529104874722339780 67,
  1.5707963267948966192313216916397514420985846996875529104874722948850 13,
  1.5707963267948966192313216916397514420985846996875529104874722961280 12,
  1.5707963267948966192313216916397514420985846996875529104874722961533 80,
  1.5707963267948966192313216916397514420985846996875529104874722961538 97}

Differenzenquotient:
{-0.9639831729384111699581281681344915142199295299205528775174945855952954,
  -27.720376320000015843000024315731973286791034401161361382230792701750 71,
  -624.960000000000015915233071904820351805715021983291753307206535994314 4,
  -15 624.960000000000015929529805246171745534579495648264375595844619670408,
  -390 624.959999999999395459722350895679190247052614433175850068156948553 9,
  -9.765624960000665342046287155277557398372760322067980924221872796610974×10^6,
  -2.441406079562113551025643363172535131911707205935829489832207013349156×10^8,
  1.718598045240010232638610067617689103863004566856056532818199018576138×10^10,
  -72.789326183984574797236722872570923845015497556742951539900021431625518,
  19.981995085715892024357496084831388449753365487013172816173828392535 67,
  43.402433619443035121885675306910952579604910806383185944542317841055 94,
  47.810565199082011674917391562649375166592582552172985687295773020257 41,
  48.742329668151023636826723583431043597042432250540271176280923675421 50,
  48.943949316127589099826480904978151018944432397899701090839229941944 4,
  48.987796446491657116368482681551379628761066776374179800077399160359 39,
  48.997342481307518354622234487443517476035334060878394263706937950191 95,
  48.999421258295224410492431470731880143662284046260121223733453715178 70,
  48.999873963231848472038981516766966006009265634258274040614131544022 60,
  48.999972552004076607307863895164434936283206898249541392147860992978 14,
  48.999994022435550382175459280486765227578765676420479302254479554685 16,
  48.999998698218675605244033204937546770042798204299810569012907725312 23,
  48.999999716500691790314685271174054958836222417810507193793804719618 72,
  48.999999938260043071199522962045160797994409545323131642915388555923 01, 0, 0}
```

In[490]:= **N[Pi / 2, genau]**

Out[490]= 1.5707963267948966192313216916397514420985846996875529104874722961539 08

--> dyyy = 49

In[543]:=
```
(* T-Matrix *)
nT = 25; dyyy = 49; genau = 40; detT = Table[0, {i, nT}]; detT[[1]] = 1;
matrixT = {{1, 0}, {-1/dyyy, dyyy/(dyyy - 1)}}; detT[[2]] = Det[matrixT];
mT = matrixT; dim = 2;
Table[{matrixT = Table[0, {i, dim + 1}, {j, dim + 1}];
  Table[Table[matrixT[[i, j]] = mT[[i, j]], {i, 1, dim}], {j, 1, dim}]; dim++;
  i = dim - 1; If[Mod[dim, 2] == 0, vz = -1, vz = 1];
  Table[
   {matrixT[[dim, j + 1]] = vz (Product[1/(dyyy^k - 1), {k, 1, i - j}]) Product[dyyy^m/(dyyy^m - 1), {m, 1, j}]; vz *= -1;}, {j, 0, i - 1}];
  matrixT[[dim, dim]] = Product[dyyy^m/(dyyy^m - 1), {m, 1, i}];
  detT[[dim]] = Det[matrixT]; mT = matrixT;}, {k, 3, nT}];
Print[TableForm[matrixT]]; (* Print["detT=\n",N[detT,genau]];*)
```

```
1
-1/49
1/115 200
-1/13 553 049 600
1/78 130 620 334 080 000
-1/22 069 966 355 263 090 851 840 000
1/305 476 742 817 533 672 040 010 088 448 000 000
-1/207 181 375 197 305 900 423 684 702 988 122 827 259 904 000 000
1/6 885 244 257 246 314 489 752 724 957 805 883 571 765 243 845 961 318 400 000 000
-1/11 212 025 373 434 721 156 772 847 023 658 741 027 245 899 456 930 507 147 674 075 214 643 200 000 000
1/894 632 914 332 685 899 615 700 944 198 567 105 676 243 291 477 361 199 018 113 184 064 394 182 271 592 038 400 000 000 000
-1/3 497 854 599 213 076 501 093 646 438 115 112 604 823 495 855 922 188 627 891 017 701 907 775 883 034 984 874 830 615 891 519 157 043 200 000 000 0
1/670 123 291 307 418 810 291 763 216 506 965 296 110 501 772 270 893 500 307 128 436 691 223 192 925 924 725 671 848 292 557 922 863 597 681 144 041 1
-1/6 290 769 220 948 192 351 097 249 933 590 685 859 380 814 363 734 355 362 132 477 699 824 407 319 324 154 865 696 120 877 010 407 286 632 616 508 8
1/2 893 669 146 146 211 014 976 292 634 509 825 803 806 750 510 576 262 535 931 601 651 329 026 665 703 207 725 139 932 288 942 244 015 237 081 430 072
-1/65 221 393 573 666 358 030 716 999 534 435 802 196 397 344 014 811 461 825 363 088 319 518 579 576 381 627 330 963 892 428 711 796 011 608 808 742
1/72 032 312 015 511 727 925 336 982 268 321 274 465 403 965 331 593 126 219 020 947 184 676 104 774 892 982 922 223 059 503 933 997 848 190 895 456 16
-1/3 898 169 462 655 497 847 005 478 590 605 752 295 660 429 030 575 817 074 281 736 252 509 621 510 236 547 884 243 712 707 287 215 150 652 943 239 9
1/10 336 896 206 511 734 161 890 287 220 955 428 071 868 469 625 222 143 446 211 552 946 207 814 231 736 142 429 689 009 738 420 353 076 577 855 409 40
-1/1 343 122 659 541 583 398 100 724 425 071 240 257 907 492 212 748 471 008 781 899 316 420 336 143 009 536 743 571 372 056 918 502 027 650 148 628 1
1/8 551 401 086 376 808 224 354 830 245 873 338 274 340 317 611 656 590 989 203 536 220 140 844 406 617 093 097 325 747 962 381 067 654 630 160 586 170
-1/2 667 810 375 328 791 568 864 642 848 280 964 034 916 329 255 558 875 576 027 864 111 627 495 339 652 504 693 699 894 919 232 441 247 494 947 524 7
1/40 782 018 550 441 599 457 495 299 797 007 842 912 628 430 518 688 347 189 049 007 530 998 691 123 323 917 092 730 451 988 293 487 363 939 242 122 69
-1/30 547 702 928 599 543 715 169 075 831 846 498 248 494 964 279 172 753 203 338 365 110 749 023 058 439 596 640 132 033 156 141 709 100 517 567 082
1/1 121 203 588 780 903 169 718 482 509 192 931 047 776 541 693 713 165 939 274 478 909 810 898 142 732 058 136 841 083 268 611 549 077 576 024 090 194
```

In[547]:=
```
nT = 25; genau = 80; Print["yyyn=", N[yyyn, genau]];
yyyyn = matrixT.yyyn;
Print["yyyyn=T(k=", nT, ")*yyyn=", N[yyyyn, genau]];
diff = Table[0, {i, nT}];
Table[diff[[i]] = (yyyyn[[i]] - yyyyn[[i + 1]])/(yyyyn[[i + 1]] - yyyyn[[i + 2]]), {i, 1, nT - 2}];
Print["Differenzenquotient:\n", N[diff, genau]];
```

yyyn=

{1.57079632679489624247790853620198337032790373820870969560856680329812246414922240,
1.59613996197489762291565518864526294677930763518077489572203499573376722924809380,
1.56984942507397955694579737765939097442385211365529457416349560440203259132808510,
1.57079784426560321708750978768163404494517968006961271638002099367788787446676160,
1.57079632669777227805122336940799985514587704448483578923079962397034113087747340,
1.57079632679489686787027162840329485659515826980807428316465357676196924236835300,
1.57079632679489661923129623100867075063102154282833978097707980325464684507854950,
1.57079632679489661923132169163985572885120475082251191052929097621979911391241000,
1.57079632679489661923132169163975144209859068018105216511107939845607415832734350,
1.57079632679489661923132169163975144209858461205168922809516658514437988273585530,
1.57079632679489661923132169163975144209858469541733747711209754315228234614590520,
1.57079632679489661923132169163975144209858469958937574913683525886327402733643320,
1.57079632679489661923132169163975144209858469968550027313485792318555513018511780,
1.57079632679489661923132169163975144209858469968751080205451746961563518111282770,
1.57079632679489661923132169163975144209858469968755205016336552199901986922241560,
1.57079632679489661923132169163975144209858469968755289292553376535042891419101580,
1.57079632679489661923132169163975144209858469968755291012904625981183736724214650,
1.57079632679489661923132169163975144209858469968755291048015739407436490913365210,
1.57079632679489661923132169163975144209858469968755291048732301206017095847876320,
1.57079632679489661923132169163975144209858469968755291048746924953807106350947420,
1.57079632679489661923132169163975144209858469968755291048747223397806732885400100,
1.57079632679489661923132169163975144209858469968755291048747229488501345825278560,
1.57079632679489661923132169163975144209858469968755291048747229612801239187547100,
1.57079632679489661923132169163975144209858469968755291048747229615337971719821190,
1.57079632679489661923132169163975144209858469968755291048747229615389741771565480}

yyyyn=T(k=25)*yyyn=

{1.570796326794896242477908536201983370327903738208709695608566803298122464149222 4,
1.597335809955601264022767218622270890068613202650944923146001198213633179908805 5,
1.569290302951535734507076722053862816959659735390425881692167683937068582881633 7,
1.570818247610012162859535497195592448298278660761534577085894293096621795807775 3,
1.570796286013107383088136793194134316156562560437611877844852523233673150229489 1,
1.570796326810487314942945104805533095418490264831744644733086884064870170879033 7,
1.570796326794895638558553399414492081253915323983776004017616476403228623815811 9,
1.570796326794896619240864938537922134336353370292847857234579990906032437822208 5,
1.570796326794896619231321671408651228888388155366941861080622894593154643170289 1,
1.570796326794896619231321691639756616091390570549369817484067972123891532321812 1,
1.570796326794896619231321691639751442098232529879575931999657838464880272154765 9,
1.570796326794896619231321691639751442098584699679907407343198891511057237716929 0,
1.570796326794896619231321691639751442098584699687507626253647587238655393433249 7,
1.570796326794896619231321691639751442098584699687552709224229396946304165301273 0,
1.570796326794896619231321691639751442098584699687552909592968980388302638178343 5,
1.570796326794896619231321691639751442098584699687552910483496725792935406313297 5,
1.570796326794896619231321691639751442098584699687552910487454626951842013306492 1,
1.570796326794896619231321691639751442098584699687552910487472217624117664627696 7,
1.570796326794896619231321691639751442098584699687552910487472295804886882835774 3,
1.570796326794896619231321691639751442098584699687552910487472296152356997036424 4,
1.570796326794896619231321691639751442098584699687552910487472296153901308891772 0,
1.570796326794896619231321691639751442098584699687552910487472296153908172501971 2,
1.570796326794896619231321691639751442098584699687552910487472296153908203006921 6,
1.570796326794896619231321691639751442098584699687552910487472296153908203142499 2,
1.570796326794896619231321691639751442098584699687552910487472296153908203143101 8}

Differenzenquotient:

{-0.946300708946278207126679736173184106054714144082939248920390496010747907854632 84,
-18.355054188959153577637723477746815994486274927488467582423249207513717914719975,
-69.573477060945556135513927057811978736637993111904480661276398547027467783923765,
-538.309002721815508171539950296927248850514410770817354877687742911428648904315 74,
-2616.612795574417623399923964626598327449998141945674606309395701810398009648626 9,
-15 898.804537344497238641779085570647684540542284740582324001232008724181256880515,
-102 761.695576056501150821532947510961529616898816393476565544965102146525581517 67,
-471 712.590420660372235836717040334498869494018907265080391956908864627013610988 47,
-3.910153100176167124057409772959122545247771793266562611793274670187883755466285 3×10^6,
-1.469175708186992345155931181437637109240036551886692180872522209330124123473397 6×10^7,
4.633679693716667178534770034618762748936376412086986382399055481809503693200382 5×10^7,
168.582921940713204979531680628982419936870305090930890611390388852240090615194 34,
225.000020839254998924148261958989753867889629271683857953120303548979924454727 28,
224.999996482310191319064384736490154686212134128797535768838711625306943201050 60,
224.999996121845091863243830998681599848744661223163115830987052460903723691992 20,
224.999994138089854554790857511638582807205866610219309118928477060859210533724 68,
224.999897871880227278790449890564317592971376791252553593672033501927136211070 5,
224.999813597258139829646606160707087352712694577325220692720046771569960181505 2,
224.999655169755743475157607441658577074089918609409623455518852640356622940712 1,
224.999359696028491875368617313073633722501869800812417512607290431871750875365 0,
224.999880981353034536152508695072783164210799406127711489140419411323854826248 60,
224.999778707655176978403913916766295989138643557907830220145939176436137269652 27,
224.999588517969966452798128739542939571849968739649870178218236800500611929504 04,
0, 0}

In[501]:= **N[Pi / 2, 80]**

Out[501]= 1.570796326794896619231321691639751442098584699687552910487472296153908203143 1045

-- > **dyyyy = 225**

In[552]:=
```
(* T-Matrix *)
nT = 25; dyyyy = 225; genau = 40; detT = Table[0, {i, nT}]; detT[[1]] = 1;
matrixT = {{1, 0}, {-1/dyyyy, dyyyy/(dyyyy - 1)}}; detT[[2]] = Det[matrixT];
mT = matrixT; dim = 2;
Table[{matrixT = Table[0, {i, dim + 1}, {j, dim + 1}];
  Table[Table[matrixT[[i, j]] = mT[[i, j]], {i, 1, dim}], {j, 1, dim}]; dim++;
  i = dim - 1; If[Mod[dim, 2] == 0, vz = -1, vz = 1];
  Table[{matrixT[[dim, j + 1]] = vz (Prod_{k=1}^{i-j} 1/(dyyyy^k - 1)) Prod_{m=1}^{j} dyyyy^m/(dyyyy^m - 1); vz *= -1;},
   {j, 0, i - 1}];
  matrixT[[dim, dim]] = Prod_{m=1}^{i} dyyyy^m/(dyyyy^m - 1);
  detT[[dim]] = Det[matrixT]; mT = matrixT;}, {k, 3, nT}];
Print[TableForm[matrixT]]; (*Print["detT=\n",N[detT,genau]];*)
```

$$1$$

$$-\frac{1}{225}$$

$$\frac{1}{11\,339\,776}$$

$$-\frac{1}{129\,167\,124\,660\,224}$$

$$\frac{1}{331\,041\,212\,720\,727\,275\,339\,776}$$

$$-\frac{1}{190\,895\,044\,628\,050\,061\,146\,053\,032\,724\,660\,224}$$

$$\frac{1}{24\,767\,932\,961\,956\,731\,113\,138\,860\,661\,908\,129\,850\,967\,275\,339\,776}$$

$$-\frac{1}{723\,048\,434\,760\,236\,939\,682\,010\,050\,990\,205\,324\,392\,579\,145\,004\,791\,749\,032\,724\,660\,224}$$

$$\frac{1}{4\,749\,277\,380\,464\,267\,186\,225\,394\,464\,435\,799\,182\,730\,381\,447\,642\,578\,807\,033\,464\,299\,587\,848\,250\,967\,275\,339\,776}$$

$$-\frac{1}{7\,018\,918\,476\,623\,937\,379\,123\,120\,853\,652\,900\,709\,617\,381\,537\,611\,887\,819\,293\,913\,670\,334\,456\,831\,622\,106\,760\,667\,068\,151\,749\,032\,724\,660\,224}$$

$$\frac{1}{2\,333\,970\,590\,227\,415\,847\,466\,206\,288\,553\,250\,562\,522\,707\,377\,410\,393\,032\,172\,754\,301\,300\,831\,671\,150\,114\,568\,758\,236\,478\,775\,821\,821\,342\,621\,835\,331}$$

$$-\frac{1}{174\,623\,656\,791\,638\,015\,688\,343\,692\,243\,676\,166\,596\,214\,155\,572\,628\,292\,342\,009\,908\,618\,231\,726\,940\,738\,480\,634\,570\,938\,000\,330\,876\,732\,718\,349\,94}$$

$$\frac{1}{2\,939\,634\,230\,511\,161\,826\,109\,738\,060\,955\,517\,043\,264\,658\,538\,387\,626\,464\,965\,983\,672\,971\,706\,638\,063\,272\,279\,091\,418\,901\,247\,889\,001\,328\,718\,818\,088}$$

$$-\frac{1}{11\,134\,379\,801\,634\,754\,062\,003\,781\,789\,484\,531\,979\,654\,054\,379\,396\,591\,615\,451\,752\,115\,299\,486\,580\,018\,544\,870\,566\,980\,754\,296\,534\,718\,213\,760\,236}$$

$$\frac{1}{9\,489\,018\,314\,954\,195\,081\,411\,486\,939\,144\,421\,113\,853\,687\,610\,032\,332\,622\,131\,057\,033\,582\,638\,048\,558\,099\,674\,669\,557\,053\,048\,035\,319\,396\,662\,305\,672}$$

$$-\frac{1}{1\,819\,529\,312\,972\,703\,807\,011\,938\,480\,626\,955\,434\,428\,864\,256\,423\,660\,829\,296\,748\,484\,264\,934\,486\,078\,183\,180\,580\,106\,447\,485\,032\,492\,795\,449\,514\,9}$$

$$\frac{1}{78\,501\,751\,440\,254\,508\,443\,864\,969\,194\,043\,707\,199\,641\,360\,723\,196\,045\,511\,629\,775\,539\,779\,300\,734\,302\,727\,350\,375\,676\,184\,962\,684\,268\,305\,903\,004\,38}$$

$$-\frac{1}{762\,047\,695\,759\,210\,161\,677\,354\,970\,311\,875\,875\,437\,715\,495\,528\,335\,678\,139\,090\,344\,075\,995\,591\,979\,438\,340\,669\,580\,150\,828\,810\,170\,168\,755\,304\,57}$$

$$\frac{1}{1\,664\,437\,455\,094\,553\,194\,151\,586\,324\,832\,739\,155\,342\,824\,975\,869\,120\,211\,286\,802\,198\,513\,266\,895\,446\,520\,161\,987\,432\,419\,093\,724\,508\,027\,205\,388\,176}$$

$$-\frac{1}{817\,966\,136\,373\,339\,693\,666\,432\,792\,025\,343\,256\,398\,992\,721\,171\,226\,387\,891\,447\,526\,146\,101\,414\,061\,144\,578\,447\,942\,827\,915\,704\,096\,614\,102\,124\,51}$$

$$\frac{1}{90\,445\,233\,971\,553\,546\,812\,759\,739\,081\,935\,401\,134\,048\,331\,020\,368\,377\,595\,825\,614\,037\,643\,575\,133\,070\,399\,680\,579\,937\,454\,222\,576\,005\,880\,779\,031\,70}$$

$$-\frac{1}{2\,250\,186\,769\,954\,441\,376\,836\,562\,696\,204\,695\,299\,946\,621\,665\,699\,267\,071\,267\,376\,718\,909\,825\,133\,536\,755\,674\,035\,558\,640\,711\,003\,181\,017\,567\,643\,7}$$

$$\frac{1}{12\,596\,038\,092\,906\,731\,552\,701\,068\,394\,092\,374\,998\,376\,685\,273\,044\,328\,119\,929\,890\,552\,655\,934\,169\,224\,925\,970\,148\,627\,730\,966\,160\,448\,504\,731\,037\,60}$$

$$-\frac{1}{15\,864\,700\,652\,943\,222\,287\,677\,745\,888\,081\,840\,878\,332\,648\,370\,450\,460\,435\,969\,437\,052\,377\,988\,002\,765\,883\,251\,743\,426\,963\,893\,543\,862\,936\,239\,986}$$

$$\frac{1}{4\,495\,855\,213\,678\,430\,858\,227\,216\,304\,976\,486\,992\,293\,948\,946\,358\,029\,332\,140\,261\,110\,639\,558\,658\,662\,101\,424\,389\,651\,611\,084\,857\,378\,347\,081\,262\,585}$$

In[556]:=
```
nT = 25; genau = 90; Print["yyyyn=", N[yyyyn, genau]];
yyyyyn = matrixT.yyyyn;
Print["yyyyyn=T(k=", nT, ")*yyyyn=", N[yyyyyn, genau]];
diff = Table[0, {i, nT}];
Table[diff[[i]] = (yyyyyn[[i]] - yyyyyn[[i + 1]])/(yyyyyn[[i + 1]] - yyyyyn[[i + 2]]), {i, 1, nT - 2}];
Print["Differenzenquotient:\n", N[diff, genau]];
```

yyyyn=

{1.57079632679489624247790853620198337032790373820870969560856680329812246414922242160208141,
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1.56929030295153573450707672205386281695965973539042588169216768393706858288163371387181252,
1.57081824761001216285953549719559244829827866076153457708589429309662179580777530834331083,
1.57079628601310738308813679319413431615656256043761187784485252323367315022948908520167290,
1.57079632681048731494294510480553309541849026483174464473308688406487017087903373024633513,
1.57079632679489563855855339941449208125391532398377600401761647640322862381581189553399290,
1.57079632679489661924086493853792213433635337029284785723457999090603243782220849456777854,
1.57079632679489661923132167140865122888838815536694186108062289459315464317028910604209690,
1.57079632679489661923132169163975661609139057054936981748406797212389153232181206814465566,
1.57079632679489661923132169163975144209823252987957593199965783846488027215476589466506298,
1.57079632679489661923132169163975144209858469967990740734319889151105723771692896561211401,
1.57079632679489661923132169163975144209858469968750762625364758723865539343324971064338610,
1.57079632679489661923132169163975144209858469968755270922422939694630416530127300950466286,
1.57079632679489661923132169163975144209858469968755290959296898038830263817834353099642479,
1.57079632679489661923132169163975144209858469968755291048349672579293540631329754521409827,
1.57079632679489661923132169163975144209858469968755291048745462695184201330649206627312082,
1.57079632679489661923132169163975144209858469968755291048747221762411766462769667411947905,
1.57079632679489661923132169163975144209858469968755291048747229580488688283577431265660673,
1.57079632679489661923132169163975144209858469968755291048747229615235699703642443614685971,
1.57079632679489661923132169163975144209858469968755291048747229615390130889177196304580961,
1.57079632679489661923132169163975144209858469968755291048747229615390817250197119510733915,
1.57079632679489661923132169163975144209858469968755291048747229615390820300692155017391043,
1.57079632679489661923132169163975144209858469968755291048747229615390820314249924065111755,
1.57079632679489661923132169163975144209858469968755291048747229615390820314310180926633250}

```
yyyyyn=T(k=25)*yyyyn=
 {1.57079632679489624247790853620198337032790373820870969560856680329812246414922242160208141,
  1.59748545638492573874677656608419086378512089180248682068353158126242857739908434206426146,
  1.56916454098541463221939794507284578431306804649232114179482636804142444064240866957173118,
  1.57082510172746507274416311538673208919460934128548191965826257103062421425387741451216766,
  1.57079618739721772949678093960448364787267994055373578678531645003821572786002471609663025,
  1.57079632699537696019790624178531386917499765913725090793673011656788246245518732663223689,
  1.57079632679482210808748969780095716482489623720612337523156684651855849554552144800559940,
  1.57079632679489662501989347475815691134249907023441177268982186954919874361648356921205411,
  1.57079632679489661923119188666258311656452000088186055458586341092574909439730915149699295,
  1.57079632679489661923132169258345200648359609542444905273726634352156249317502381863906976,
  1.57079632679489661923132169163974955259615708946478119296253501394070223468966686558885404,
  1.57079632679489661923132169163975144209920195295354218139464299851053465582957980561305939,
  1.57079632679489661923132169163975144209858469961604870694252333205062520940325599859669091,
  1.57079632679489661923132169163975144209858469968755291346716536048535041399180199153397370,
  1.57079632679489661923132169163975144209858469968755291048747226088216655421907238683265216,
  1.57079632679489661923132169163975144209858469968755291048747229608519789634928172669838079,
  1.57079632679489661923132169163975144209858469968755291048747229615344563454855951996439183,
  1.57079632679489661923132169163975144209858469968755291048747229615390461863334951504426935,
  1.57079632679489661923132169163975144209858469968755291048747229615390817405921352473317506,
  1.57079632679489661923132169163975144209858469968755291048747229615390820290396533770839724,
  1.57079632679489661923132169163975144209858469968755291048747229615390820314113091007514962,
  1.57079632679489661923132169163975144209858469968755291048747229615390820314308819489294662,
  1.57079632679489661923132169163975144209858469968755291048747229615390820314310436458062513,
  1.57079632679489661923132169163975144209858469968755291048747229615390820314310449820054834,
  1.57079632679489661923132169163975144209858469968755291048747229615390820314310449930481525}
```

Differenzenquotient:

```
{-0.9423823069818647467682255829953891253982323709661031336944901889103784314678767622052905 98,
 -17.055031280903810382675804570776944439453716244341427482577521255448600454711658331340 1869,
 -57.430371993590230778447991158581857350723544027962530588213145265034463029099940973806 9382,
 -207.125440669738167112627151612978370633617492709980343954120140442434057226558469127332 654,
 -696.059745060890443308371847770327255679149987013431463840049992124762700064120335416516 992,
 -2691.399734810490432622376096786178744083642652297182015510767420625579089153737263766014 38,
 -12 872.823252285198404326420249309988441508900240040208821264339137397083245547979857237 1395,
 -44 595.050436431435714740238946320344521413086849884621091263667071101619847357282341821 1361,
 -137 549.627357833109821890430280359192483244913849526428360579400038217084481574724924483 935,
 -499 444.791291997538557453014298526519740728761295258553276298661701653552082685318135609 642,
 -3.061146744927020213383909877450010691550783578656644221781311228820948620239765462511195 29 × 10^6,
 -8.632405944967090283893948554453293202321398758214401236014124066646896553116981926960445 24 × 10^6,
 -2.399717156581142314013550461110689945177331155204839456034401329599283528853245912498641 19 × 10^7,
 -8.464308288238669545387054975235956606330144493874344273525329662353837492860865294990409 41 × 10^7,
 515.812425011657493239597564882381562239063713187135061172464404434875061030187509573720483,
 148.693038518980593723544901291928056759681540153431575009292731079578865946515766724955379,
 129.093982646671858843251741107536722439615691597681985052843230563635731962694320761213031,
 123.260754228793649485624477164947189858776988540764514287654243416849464592575374727267428,
 121.622845698572786603198407297232984503816409493276551398723294362043168353290392206920099,
 121.170700457223474631769956569127560869462565741516951655615064297687021753690096022098757,
 121.046544417747630525521440917325406755226771866420755973028768208696429036644681619983265,
 121.012550296812609924760299091803798547977926137903337889776240510313833694312150530818148,
 121.003284855438264916708700738010076151653146551033719247753649167801579396396805244656248, 0, 0}
```

In[561]:= **N[Pi / 2, 90]**

Out[561]= 1.57079632679489661923132169163975144209858469968755291048747229615390820314310449931401741

-- > dyyyy = 121