results

December 31, 2022

[399]:
```
import joblib
import pandas as pd

res_edge_df = pd.DataFrame(joblib.load("res_fakeedge_2022_12_30_03_56_24.
 ↪joblib"))
res_rwp_df = pd.DataFrame(joblib.load("res_rwp_2022_12_31_04_47_15.joblib"))
res_manh_df = pd.DataFrame(joblib.load("res_manh_2022_12_31_04_51_56.joblib"))
```

[400]:
```
import numpy as np


def zeros_to_nan(arr: np.ndarray):
    arr[np.all(arr == 0, axis=1)] = np.nan
    return arr


res_manh_df["res_list"] = res_manh_df["res_list"].transform(lambda l:␣
 ↪[zeros_to_nan(arr) for arr in l])
res_rwp_df["res_list"] = res_rwp_df["res_list"].transform(lambda l:␣
 ↪[zeros_to_nan(arr) for arr in l])
res_edge_df["res_list"] = res_edge_df["res_list"].transform(lambda l:␣
 ↪[zeros_to_nan(arr) for arr in l])
```

[401]:
```
res_manh_df["res_list"] = res_manh_df["res_list"].transform(np.dstack)
res_rwp_df["res_list"] = res_rwp_df["res_list"].transform(np.dstack)
res_edge_df["res_list"] = res_edge_df["res_list"].transform(np.dstack)
```

[402]:
```
res_manh_df["res_list"] = res_manh_df["res_list"].transform(np.dstack)
res_rwp_df["res_list"] = res_rwp_df["res_list"].transform(np.dstack)
res_edge_df["res_list"] = res_edge_df["res_list"].transform(np.dstack)
```

[403]:
```
res_manh_df["succ_rate"] = res_manh_df["res_list"].transform(
    lambda arr: np.mean(np.all(~np.isnan(arr), axis=0).sum(axis=1) == 1000))
res_rwp_df["succ_rate"] = res_rwp_df["res_list"].transform(
    lambda arr: np.mean(np.all(~np.isnan(arr), axis=0).sum(axis=1) == 1000))
res_edge_df["succ_rate"] = res_edge_df["res_list"].transform(
    lambda arr: np.mean(np.all(~np.isnan(arr), axis=0).sum(axis=1) == 1000))
```

[404]:
```
res_manh_df["exp_mean"] = res_manh_df["res_list"].transform(lambda arr: np.
    ↪nanmean(arr, axis=1))
res_rwp_df["exp_mean"] = res_rwp_df["res_list"].transform(lambda arr: np.
    ↪nanmean(arr, axis=1))
res_edge_df["exp_mean"] = res_edge_df["res_list"].transform(lambda arr: np.
    ↪nanmean(arr, axis=1))
```

```
/tmp/ipykernel_1037256/3456749177.py:1: RuntimeWarning: Mean of empty slice
  res_manh_df["exp_mean"] = res_manh_df["res_list"].transform(lambda arr:
np.nanmean(arr, axis=1))
/tmp/ipykernel_1037256/3456749177.py:2: RuntimeWarning: Mean of empty slice
  res_rwp_df["exp_mean"] = res_rwp_df["res_list"].transform(lambda arr:
np.nanmean(arr, axis=1))
/tmp/ipykernel_1037256/3456749177.py:3: RuntimeWarning: Mean of empty slice
  res_edge_df["exp_mean"] = res_edge_df["res_list"].transform(lambda arr:
np.nanmean(arr, axis=1))
```

[405]:
```
res_manh_df["exp_std"] = res_manh_df["res_list"].transform(lambda arr: np.
    ↪nanstd(arr, axis=1))
res_rwp_df["exp_std"] = res_rwp_df["res_list"].transform(lambda arr: np.
    ↪nanstd(arr, axis=1))
res_edge_df["exp_std"] = res_edge_df["res_list"].transform(lambda arr: np.
    ↪nanstd(arr, axis=1))
```

```
/home/ania/PycharmProjects/py4j_test/venv/lib/python3.10/site-
packages/numpy/lib/nanfunctions.py:1872: RuntimeWarning: Degrees of freedom <= 0
for slice.
  var = nanvar(a, axis=axis, dtype=dtype, out=out, ddof=ddof,
/home/ania/PycharmProjects/py4j_test/venv/lib/python3.10/site-
packages/numpy/lib/nanfunctions.py:1872: RuntimeWarning: Degrees of freedom <= 0
for slice.
  var = nanvar(a, axis=axis, dtype=dtype, out=out, ddof=ddof,
/home/ania/PycharmProjects/py4j_test/venv/lib/python3.10/site-
packages/numpy/lib/nanfunctions.py:1872: RuntimeWarning: Degrees of freedom <= 0
for slice.
  var = nanvar(a, axis=axis, dtype=dtype, out=out, ddof=ddof,
```

[406]:
```
from operator import itemgetter

res_edge_df["p"] = res_edge_df["pq"].transform(itemgetter(0))
```

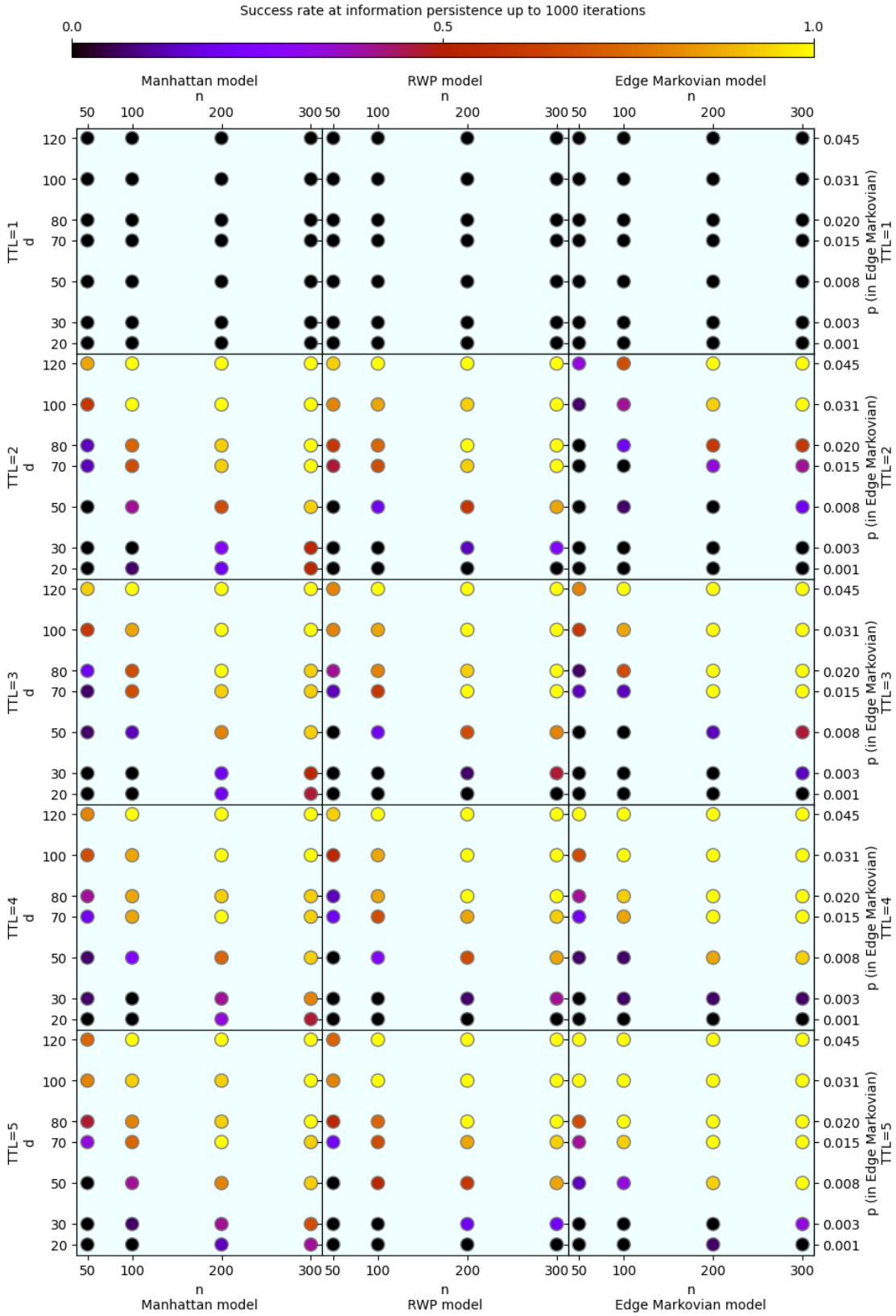
[407]:
```
nArray = [50, 100, 200, 300]
ttlArray = [1, 2, 3, 4, 5]
dArray = [20, 30, 50, 70, 80, 100, 120]
pArray = [x*x*np.pi/1000/1000 for x in dArray]
```

[408]:
```
res_edge_df["d"] = res_manh_df["d"]
```

1 Success rate

[409]:
```
from matplotlib.cm import ScalarMappable
from matplotlib import pyplot as plt

fig: plt.Figure = plt.figure(figsize=(10, 15))
gs = fig.add_gridspec(5, 3, hspace=0, wspace=0)
axes = gs.subplots(sharex='col', sharey='row')
colormap = 'gnuplot'
for ind, res, name in zip(range(3), [res_manh_df, res_rwp_df, res_edge_df],
                          ["Manhattan model", "RWP model", "Edge Markovian␣
 ↪model"]):
    row_ind = 0
    for ttl, df in res.groupby("ttl", sort=True):
        ax: plt.Axes = axes[row_ind, ind]
        ax.scatter(df["n"], df["d"], c=df["succ_rate"], cmap=colormap, s=100,␣
 ↪edgecolors="gray")
        ax.set_ylabel(f"TTL={ttl}\nd")
        ax.set_xlabel(f"n\n{name}")
        # pl = df.plot(ax=ax, kind='scatter', x="n", y="d", c="succ_rate",␣
 ↪cmap="jet",colorbar=False)
        ax.set_yticks(dArray)
        ax.set_xticks(nArray)
        ax.tick_params(axis="x", bottom=True, top=False, labelbottom=True,␣
 ↪labeltop=False)
        ax.label_outer()
        if row_ind == 0:
            ax3: plt.Axes = ax.twiny()
            ax3.set_xlabel(f"{name}\nn")
            ax3.set_xlim(*ax.get_xlim())
            ax3.set_xticks(nArray)
            ax3.label_outer()
            ax3.set_xticklabels(nArray)
        if ind == 2:
            ax2: plt.Axes = ax.twinx()  # instantiate a second axes that shares␣
 ↪the same x-axis
            ax2.set_ylabel(f'p (in Edge Markovian)\nTTL={ttl}')
            ax2.set_ylim(*ax.get_ylim())
            ax2.set_yticks(dArray)
            ax2.label_outer()
            ax2.set_yticklabels(["%.3f" % p for p in pArray])  # ax2.
 ↪tick_params(axis='y', )
        facecol = "powderblue" if ind == 0 else "paleturquoise" if ind == 1␣
 ↪else "lavender"
        ax.set_facecolor("azure")
        row_ind += 1
# for ax in chain.from_iterable(axes):
```

```
#     ax.label_outer()
# fig.suptitle("Infomation persistance success rate at 1000 iterations")
fig.subplots_adjust(top=0.9)
cbar_ax: plt.Axes = fig.add_axes([0.12, 0.95, 0.78, 0.01])
plt.colorbar(ScalarMappable(cmap=colormap), cax=cbar_ax,
             label="Success rate at information persistence up to 1000␣
 ↪iterations", orientation='horizontal')
cbar_ax.xaxis.set_ticks_position('top')
cbar_ax.xaxis.set_label_position("top")
cbar_ax.xaxis.set_ticks([0.0, 0.5, 1.0])

plt.savefig("success_rate.pdf", bbox_inches='tight', pad_inches=0)
# plt.show()
```

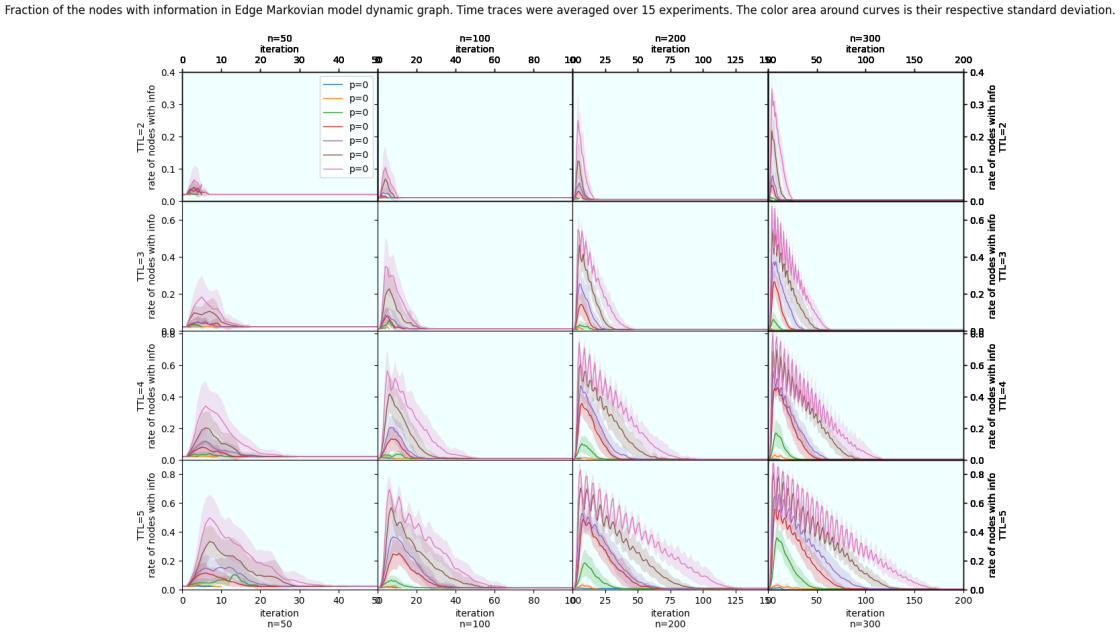

Success rate at information persistence up to 1000 iterations
0.0
0.5
1.0
Manhattan model
RWP model
Edge Markovian model
n
50
100
200
300
d
120
100
80
70
50
30
20
p (in Edge Markovian)
0.045
0.031
0.020
0.015
0.008
0.003
0.001
TTL=1
TTL=2
TTL=3
TTL=4
TTL=5

2 Fraction of nodes with information

2.1 Edge Markovian

[410]:
```
fig: plt.Figure = plt.figure(figsize=(15, 10))
gs = fig.add_gridspec(4, 4, hspace=0, wspace=0)
axes = gs.subplots(sharex='col', sharey='row')
colormap = 'gnuplot'
xlims = [50, 100, 150, 200]
ylims = [0.4, 0.7, 0.82, 0.9]
for ttl, df_ttl in res_edge_df.groupby("ttl", sort=True):
    ttl = int(ttl)
    if ttl == 1: continue
    ind_ttl = ttlArray.index(ttl) - 1
    for n, df_n in df_ttl.groupby("n", sort=True):
        n = int(n)
        ind_n = nArray.index(n)
        ax: plt.Axes = axes[ind_ttl, ind_n]
        for exp_no in range(len(df_n)):
            l = np.sum(~np.isnan(df_n["exp_mean"].iloc[exp_no][0, :]))
            # l=1000
            d = int(df_n["p"].iloc[exp_no])
            val = df_n["exp_mean"].iloc[exp_no][0, :l] / n
            err = df_n["exp_std"].iloc[exp_no][0, :l] / n
            ax.plot(range(l), val, label=f"p={d}", linewidth=1)
            lower = val - err
            upper = val + err
            ax.fill_between(range(l), lower, upper, alpha=0.2)
            # ax.legend()
            ax.set_xlim(0, xlims[ind_n])
            ax.set_ylim(0, ylims[ind_ttl])
            ax.set_xlabel(f"iteration\nn={n}")
            ax.set_ylabel(f"TTL={ttl}\nrate of nodes with info")
            ax.label_outer()
            if ttl == 2:
                ax3: plt.Axes = ax.twiny()
                ax3.set_xlabel(f"n={n}\niteration")
                ax3.set_xlim(*ax.get_xlim())
                # ax3.set_xticks(ax.get_xticks())
                ax3.label_outer()  # ax3.set_xticklabels(ax.get_xticklabels())␣
↪# ax3.tick_params(axis="x", bottom=False, top=True, labelbottom=False,␣
↪labeltop=True)
            if n == 300:
                ax2: plt.Axes = ax.twinx()  # instantiate a second axes that␣
↪shares the same x-axis
```

```
                ax2.set_ylabel(f'rate of nodes with info\nTTL={ttl}')
                ax2.set_ylim(*ax.get_ylim())
                # ax2.set_yticks(ax.get_yticks())
                ax2.label_outer()  # ax2.set_yticklabels(ax.get_yticklabels()) ␣
 ↪# ax2.tick_params(axis='y', )
        ax.set_facecolor("azure")
axes[0][0].legend()
fig.suptitle(
    "Fraction of the nodes with information in Edge Markovian model dynamic␣
 ↪graph. Time traces were averaged over 15 experiments. The color area around␣
 ↪curves is their respective standard deviation.")
plt.savefig("frac_info_edge.pdf", bbox_inches='tight', pad_inches=0, dpi=500)
```

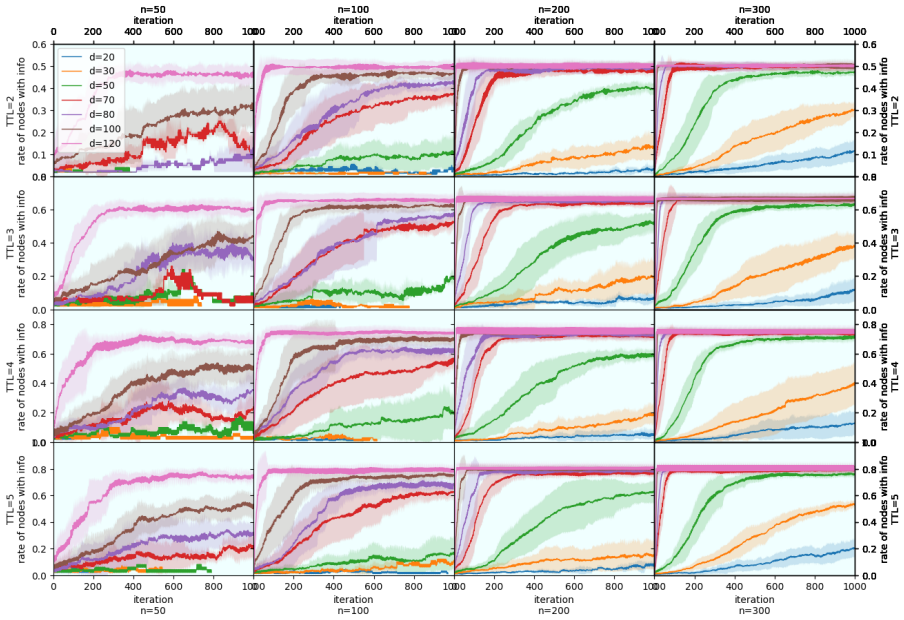


2.2 Manhattan

[411]:
```
fig: plt.Figure = plt.figure(figsize=(15, 10))
gs = fig.add_gridspec(4, 4, hspace=0, wspace=0)
axes = gs.subplots(sharex='col', sharey='row')
colormap = 'gnuplot'
xlims = [1000] * 5
ylims = [0.6, 0.8, 0.9, 1]
for ttl, df_ttl in res_manh_df.groupby("ttl", sort=True):
    ttl = int(ttl)
    if ttl == 1: continue
    ind_ttl = ttlArray.index(ttl) - 1
    for n, df_n in df_ttl.groupby("n", sort=True):
```

```
        n = int(n)
        ind_n = nArray.index(n)
        ax: plt.Axes = axes[ind_ttl, ind_n]
        for exp_no in range(len(df_n)):
            l = np.sum(~np.isnan(df_n["exp_mean"].iloc[exp_no][0, :]))
            # l=1000
            d = int(df_n["d"].iloc[exp_no])
            val = df_n["exp_mean"].iloc[exp_no][0, :l] / n
            err = df_n["exp_std"].iloc[exp_no][0, :l] / n
            ax.plot(range(l), val, label=f"d={d}", linewidth=1)
            lower = val - err
            upper = val + err
            ax.fill_between(range(l), lower, upper, alpha=0.2)
            # ax.legend()
            ax.set_xlim(0, xlims[ind_n])
            ax.set_ylim(0, ylims[ind_ttl])
            ax.set_xlabel(f"iteration\nn={n}")
            ax.set_ylabel(f"TTL={ttl}\nrate of nodes with info")
            ax.label_outer()
            if ttl == 2:
                ax3: plt.Axes = ax.twiny()
                ax3.set_xlabel(f"n={n}\niteration")
                ax3.set_xlim(*ax.get_xlim())
                # ax3.set_xticks(ax.get_xticks())
                ax3.label_outer()  # ax3.set_xticklabels(ax.get_xticklabels())

            if n == 300:
                ax2: plt.Axes = ax.twinx()  # instantiate a second axes that␣
 ↪shares the same x-axis
                ax2.set_ylabel(f'rate of nodes with info\nTTL={ttl}')
                ax2.set_ylim(*ax.get_ylim())
                # ax2.set_yticks(ax.get_yticks())
                ax2.label_outer()  # ax2.set_yticklabels(ax.get_yticklabels()) ␣
 ↪# ax2.tick_params(axis='y', )
        ax.set_facecolor("azure")
axes[0][0].legend()
fig.suptitle(
    "Fraction of the nodes with information in Manhattan model dynamic graph.␣
 ↪Time traces were averaged over 15 experiments. The color area around curves␣
 ↪is their respective standard deviation.")
plt.savefig("frac_info_manhattan.pdf", bbox_inches='tight', pad_inches=0,␣
 ↪dpi=500)
```

Fraction of the nodes with information in Manhattan model dynamic graph. Time traces were averaged over 15 experiments. The color area around curves is their respective standard deviation.

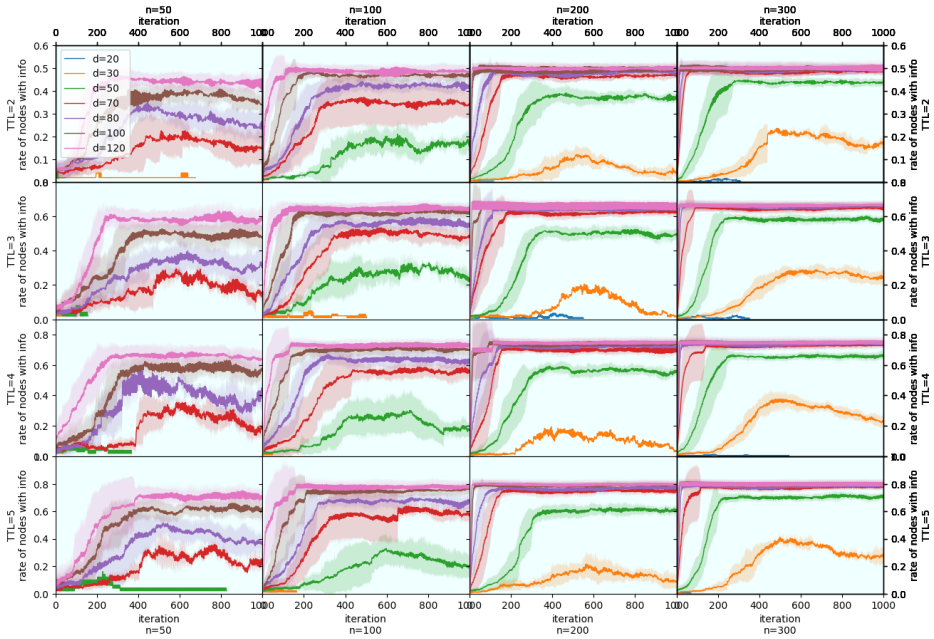


3 RWP

[412]:
```
fig: plt.Figure = plt.figure(figsize=(15, 10))
gs = fig.add_gridspec(4, 4, hspace=0, wspace=0)
axes = gs.subplots(sharex='col', sharey='row')
colormap = 'gnuplot'
xlims = [1000] * 5
ylims = [0.6, 0.8, 0.9, 1]
for ttl, df_ttl in res_rwp_df.groupby("ttl", sort=True):
    ttl = int(ttl)
    if ttl == 1: continue
    ind_ttl = ttlArray.index(ttl) - 1
    for n, df_n in df_ttl.groupby("n", sort=True):
        n = int(n)
        ind_n = nArray.index(n)
        ax: plt.Axes = axes[ind_ttl, ind_n]
        for exp_no in range(len(df_n)):
            l = np.sum(~np.isnan(df_n["exp_mean"].iloc[exp_no][0, :]))
            # l=1000
            d = int(df_n["d"].iloc[exp_no])
            val = df_n["exp_mean"].iloc[exp_no][0, :l] / n
            err = df_n["exp_std"].iloc[exp_no][0, :l] / n
            ax.plot(range(l), val, label=f"d={d}", linewidth=1)
            lower = val - err
            upper = val + err
```

```
            ax.fill_between(range(l), lower, upper, alpha=0.2)
            # ax.legend()
            ax.set_xlim(0, xlims[ind_n])
            ax.set_ylim(0, ylims[ind_ttl])
            ax.set_xlabel(f"iteration\nn={n}")
            ax.set_ylabel(f"TTL={ttl}\nrate of nodes with info")
            ax.label_outer()
            if ttl == 2:
                ax3: plt.Axes = ax.twiny()
                ax3.set_xlabel(f"n={n}\niteration")
                ax3.set_xlim(*ax.get_xlim())
                # ax3.set_xticks(ax.get_xticks())
                ax3.label_outer()  # ax3.set_xticklabels(ax.get_xticklabels())

            if n == 300:
                ax2: plt.Axes = ax.twinx()  # instantiate a second axes that␣
 ↪shares the same x-axis
                ax2.set_ylabel(f'rate of nodes with info\nTTL={ttl}')
                ax2.set_ylim(*ax.get_ylim())
                # ax2.set_yticks(ax.get_yticks())
                ax2.label_outer()  # ax2.set_yticklabels(ax.get_yticklabels()) ␣
 ↪# ax2.tick_params(axis='y', )
        ax.set_facecolor("azure")

axes[0][0].legend()
fig.suptitle(
    "Fraction of the nodes with information in RWP model dynamic graph. Time␣
 ↪traces were averaged over 15 experiments. The color area around curves is␣
 ↪their respective standard deviation.")
plt.savefig("frac_info_rwp.pdf", bbox_inches='tight', pad_inches=0, dpi=500)
```

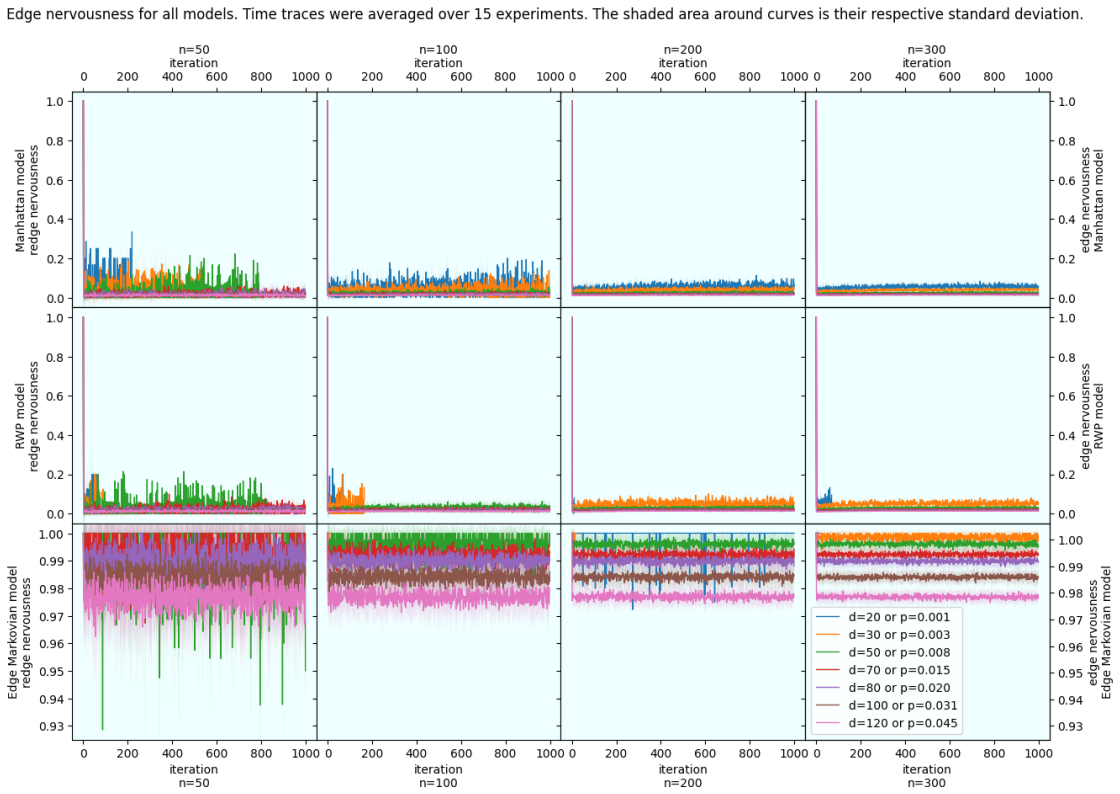
Fraction of the nodes with information in RWP model dynamic graph. Time traces were averaged over 15 experiments. The color area around curves is their respective standard deviation.



4 Nervousness

[421]:
```
fig: plt.Figure = plt.figure(figsize=(15, 10))
gs = fig.add_gridspec(3, 4, hspace=0, wspace=0)
axes = gs.subplots(sharex='col', sharey='row')
colormap = 'gnuplot'
xlims = [1000] * 5
ylims = [1.1] * 5
ttl = 5
ylabelnames = ["Manhattan model", "RWP model", "Edge Markovian model"]

for row, df in enumerate([res_manh_df, res_rwp_df, res_edge_df]):
    df_ttl = df.groupby("ttl", sort=True).get_group(ttl)

    for n, df_n in df_ttl.groupby("n", sort=True):
        n = int(n)
        ind_n = nArray.index(n)
        ax: plt.Axes = axes[row][ind_n]
        for exp_no in range(len(df_n)):
            l = np.sum(~np.isnan(df_n["exp_mean"].iloc[exp_no][0, :]))
            # l=1000
            d = int(df_n["d"].iloc[exp_no])
            ind_d = dArray.index(d)
            p = pArray[ind_d]
```

```
            label = f"d=%d or p=%.3f" % (d, p)
            val = df_n["exp_mean"].iloc[exp_no][1, :l]
            err = df_n["exp_std"].iloc[exp_no][1, :l]
            ax.plot(range(l), val, label=label, linewidth=1)
            lower = val - err
            upper = val + err
            ax.fill_between(range(l), lower, upper,
                            alpha=0.2)  # ax.legend()  # ax.
 ↪set_xlim(0,xlims[ind_n])  # ax.set_ylim(0.6,ylims[ind_ttl])
        name = ylabelnames[row]
        ax.set_xlabel(f"iteration\nn={n}")
        ax.set_ylabel(f"{name}\nredge nervousness")
        ax.label_outer()
        if row == 0:
            ax3: plt.Axes = ax.twiny()
            ax3.set_xlabel(f"n={n}\niteration")
            ax3.set_xlim(*ax.get_xlim())
            # ax3.set_xticks(ax.get_xticks())
            ax3.label_outer()  # ax3.set_xticklabels(ax.get_xticklabels())  #␣
 ↪ax3.tick_params(axis="x", bottom=False, top=True, labelbottom=False,␣
 ↪labeltop=True)
        if n == 300:
            ax2: plt.Axes = ax.twinx()  # instantiate a second axes that shares␣
 ↪the same x-axis
            ax2.set_ylabel(f'edge nervousness\n{name}')
            ax2.set_ylim(*ax.get_ylim())
            # ax2.set_yticks(ax.get_yticks())
            ax2.label_outer()  # ax2.set_yticklabels(ax.get_yticklabels())  #␣
 ↪ax2.tick_params(axis='y', )
        ax.set_facecolor("azure")
        ax.relim()
        # update ax.viewLim using the new dataLim
        ax.autoscale_view()

axes[2][3].legend()
fig.suptitle(
    "Edge nervousness for all models. Time traces were averaged over 15␣
 ↪experiments. The shaded area around curves is their respective standard␣
 ↪deviation.")
plt.savefig("nervousness.pdf", bbox_inches='tight', pad_inches=0, dpi=500)
# fig.subplots_adjust(top=0.9)
```

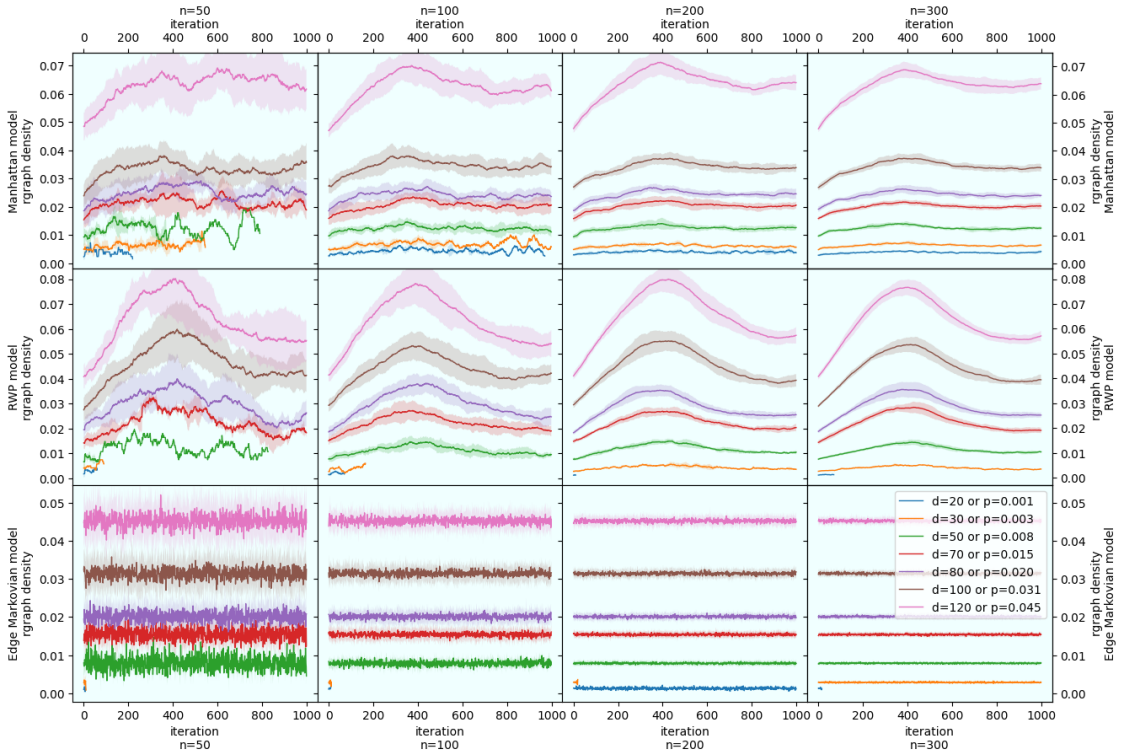


5 Graph density

[422]:
```
fig: plt.Figure = plt.figure(figsize=(15, 10))
gs = fig.add_gridspec(3, 4, hspace=0, wspace=0)
axes = gs.subplots(sharex='col', sharey='row')
colormap = 'gnuplot'
xlims = [1000] * 5
ylims = [1.1] * 5
ttl = 5
ylabelnames = ["Manhattan model", "RWP model", "Edge Markovian model"]

for row, df in enumerate([res_manh_df, res_rwp_df, res_edge_df]):
    df_ttl = df.groupby("ttl", sort=True).get_group(ttl)

    for n, df_n in df_ttl.groupby("n", sort=True):
        n = int(n)
        ind_n = nArray.index(n)
        ax: plt.Axes = axes[row][ind_n]
        for exp_no in range(len(df_n)):
            l = np.sum(~np.isnan(df_n["exp_mean"].iloc[exp_no][0, :]))
            # l=1000
```

```
            d = int(df_n["d"].iloc[exp_no])
            ind_d = dArray.index(d)
            p = pArray[ind_d]
            label = f"d=%d or p=%.3f" % (d, p)
            val = df_n["exp_mean"].iloc[exp_no][2, :l]
            err = df_n["exp_std"].iloc[exp_no][2, :l]
            ax.plot(range(l), val, label=label, linewidth=1)
            lower = val - err
            upper = val + err
            ax.fill_between(range(l), lower, upper,
                            alpha=0.2)  # ax.legend()  # ax.
 ↪set_xlim(0,xlims[ind_n])  # ax.set_ylim(0.6,ylims[ind_ttl])
        name = ylabelnames[row]
        ax.set_xlabel(f"iteration\nn={n}")
        ax.set_ylabel(f"{name}\nrgraph density")
        ax.label_outer()
        if row == 0:
            ax3: plt.Axes = ax.twiny()
            ax3.set_xlabel(f"n={n}\niteration")
            ax3.set_xlim(*ax.get_xlim())
            # ax3.set_xticks(ax.get_xticks())
            ax3.label_outer()
        # ax3.set_xticklabels(ax.get_xticklabels())
        # ax3.tick_params(axis="x", bottom=False, top=True, labelbottom=False,␣
 ↪labeltop=True)
        if n == 300:
            ax2: plt.Axes = ax.twinx()  # instantiate a second axes that shares␣
 ↪the same x-axis
            ax2.set_ylabel(f'rgraph density\n{name}')
            ax2.set_ylim(*ax.get_ylim())
            # ax2.set_yticks(ax.get_yticks())
            ax2.label_outer()  # ax2.set_yticklabels(ax.get_yticklabels())  #␣
 ↪ax2.tick_params(axis='y', )
        ax.set_facecolor("azure")
        ax.relim()
        # update ax.viewLim using the new dataLim
        ax.autoscale_view()

axes[2][3].legend()
fig.suptitle(
    "Graph density for all models. Time traces were averaged over 15␣
 ↪experiments. The shaded area around curves is their respective standard␣
 ↪deviation.")
plt.savefig("density.pdf", bbox_inches='tight', pad_inches=0, dpi=500)
```

Graph density for all models. Time traces were averaged over 15 experiments. The shaded area around curves is their respective standard deviation.

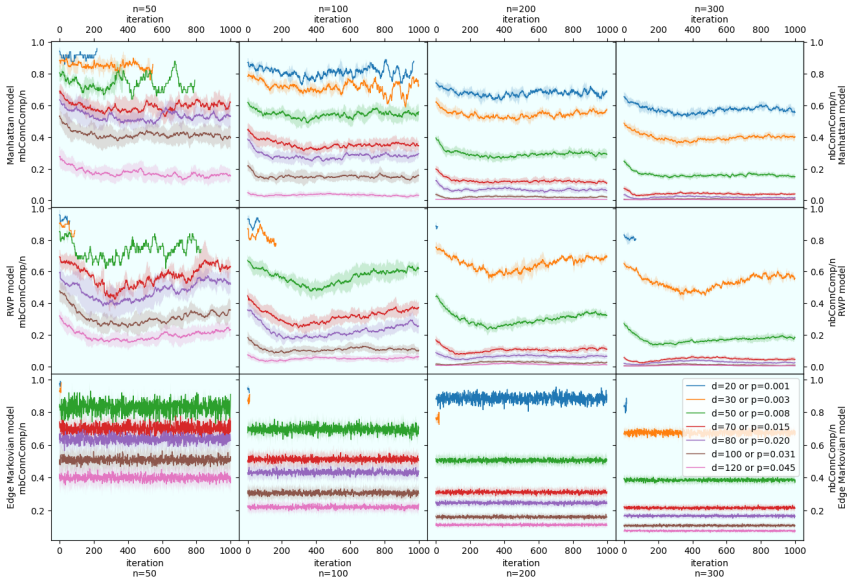


6 Connected components relative to nodes number

[424]:
```
fig: plt.Figure = plt.figure(figsize=(15, 10))
gs = fig.add_gridspec(3, 4, hspace=0, wspace=0)
axes = gs.subplots(sharex='col', sharey='row')
colormap = 'gnuplot'
xlims = [1000] * 5
ylims = [1.1] * 5
ttl = 5
ylabelnames = ["Manhattan model", "RWP model", "Edge Markovian model"]

for row, df in enumerate([res_manh_df, res_rwp_df, res_edge_df]):
    df_ttl = df.groupby("ttl", sort=True).get_group(ttl)

    for n, df_n in df_ttl.groupby("n", sort=True):
        n = int(n)
        ind_n = nArray.index(n)
        ax: plt.Axes = axes[row][ind_n]
        for exp_no in range(len(df_n)):
            l = np.sum(~np.isnan(df_n["exp_mean"].iloc[exp_no][3, :]))
            # l=1000
```

```
            d = int(df_n["d"].iloc[exp_no])
            ind_d = dArray.index(d)
            p = pArray[ind_d]
            label = f"d=%d or p=%.3f" % (d, p)
            val = df_n["exp_mean"].iloc[exp_no][3, :l] / n
            err = df_n["exp_std"].iloc[exp_no][3, :l] / n
            ax.plot(range(l), val, label=label, linewidth=1)
            lower = val - err
            upper = val + err
            ax.fill_between(range(l), lower, upper,
                            alpha=0.2)  # ax.legend()  # ax.
 ↪set_xlim(0,xlims[ind_n])  # ax.set_ylim(0.6,ylims[ind_ttl])
        name = ylabelnames[row]
        ax.set_xlabel(f"iteration\nn={n}")
        ax.set_ylabel(f"{name}\nrnbConnComp/n")
        ax.label_outer()
        ax.relim()
        # update ax.viewLim using the new dataLim
        ax.autoscale_view()
        if row == 0:
            ax3: plt.Axes = ax.twiny()
            ax3.set_xlabel(f"n={n}\niteration")
            ax3.set_xlim(*ax.get_xlim())
            # ax3.set_xticks(ax.get_xticks())
            ax3.label_outer()
        # ax3.set_xticklabels(ax.get_xticklabels())
        # ax3.tick_params(axis="x", bottom=False, top=True, labelbottom=False,␣
 ↪labeltop=True)
        if n == 300:
            ax2: plt.Axes = ax.twinx()  # instantiate a second axes that shares␣
 ↪the same x-axis
            ax2.set_ylabel(f'nbConnComp/n\n{name}')
            ax2.set_ylim(*ax.get_ylim())
            # ax2.set_yticks(ax.get_yticks())
            ax2.label_outer()  # ax2.set_yticklabels(ax.get_yticklabels())  #␣
 ↪ax2.tick_params(axis='y', )
        ax.set_facecolor("azure")

axes[2][3].legend()
fig.suptitle(
    "Number of connected components normalized to the number of nodes for all␣
 ↪models. Time traces were averaged over 15 experiments. The shaded area␣
 ↪around curves is their respective standard deviation.")
plt.savefig("conn_comp.pdf", bbox_inches='tight', pad_inches=0, dpi=500)
```

Number of connected components normalized to the number of nodes for all models. Time traces were averaged over 15 experiments. The shaded area around curves is their respective standard deviation.



[ ]:
```
!jupyter nbconvert --to pdf results.ipynb
```